ARCOM

ASSOCIATION OF RESEARCHERS IN **CONSTRUCTION MANAGEMENT**

THIRTY-SECOND ANNUAL CONFERENCE 2016

September 5-7

Manchester

Volume 2

Association of Researchers in Construction Management (ARCOM)

PROCEEDINGS OF THE 32ND ANNUAL CONFERENCE

Edited by Paul W Chan and Christopher James Neilson

First published 2016

ISBN: 978-0-9955463-0-1 (2 vols)

Published by

ARCOM, Association of Researchers in Construction Management

School of Mechanical, Aerospace and Civil Engineering (MACE)

The University of Manchester

Sackville Street

Manchester

M13 9PL, UK

Dr Paul W Chan

School of Mechanical, Aerospace and Civil Engineering (MACE)

The University of Manchester

Sackville Street

Manchester

M13 9PL, UK

Email: paul.chan@manchester.ac.uk

ARCOM Declaration:

The papers in these proceedings were double-blind refereed by members of the scientific committee in a process that involved, detailed reading of the papers, reporting of comments to authors, modifications of papers by authors and re-evaluation of re-submitted papers to ensure quality of content.

TABLE OF CONTENTS

VOLUME 2

HUMAN RESOUSE MANAGEMENT

INFORMATION, KNOWLEDGE AND LEARNING

PRACTICES AND PRACTICE-BASED PERSPECTIVES

PROJECTS AND COLLABORATION

RESEARCH METHODS

SOCIAL VALUE

STRATEGY AND INNOVATION

SUSTAINABILITY

VALUE AND PERFORMANCE MANAGMENT

HUMAN RESOURCE MANAGEMENT

EXPLORING HUMAN RESOURCE INCENTIVISATION FOR PUBLIC SECTOR CONSTRUCTION PROJECT DELIVERY IN SCOTLAND

Bolutife Oyemomi[1], Billy Hare and Michael Tong

Department of Construction and Surveying, School of Engineering and Built Environment, Glasgow Caledonian University, Cowcaddens Road, Glasgow, G4 0BA, UK

The construction industry is largely accepted to be significantly human resource dependent. This assertion justifies the importance attached to the motivational well-being of human resources. This importance is evidenced in the engagement of human resources, for the achievement of project goals, with incentives and rewards. These arguments emphasise the influence held within human behaviours towards either successful delivery or failure of construction projects. This research aims to critically evaluate the types and prevalence of incentive schemes implemented towards the successful delivery of public sector construction projects. This research seeks to answer the question: how do workforce incentive schemes operate when administered to aid construction project delivery? A critical literature review provided 5 categories of incentives; financial, non-financial, intrinsic, extrinsic and disincentives. This review justified the need for further understanding on human resource incentivisation. This revelation aided the adoption of a qualitative phenomenological approach to analyse the experiences of 9 purposive sampled professionals in public construction projects in Scotland. The thematic analysis generated 4 initial themes, namely; incentives as corruption, financial dominance, the need to move beyond financial incentives and management hierarchical tensions. This research recognises the need for approaches drawn from experiential attributes of engaged human resources within construction projects.

Keywords: human resource management, incentives, motivation, public sector, reward

INTRODUCTION

The construction industry is largely considered to be significantly human resource dependent (Grebler and Burns 1982). This understanding reinforces the need for a deliberate consideration of the human resource in management, practice and research. This consideration recognises the need to sustain the productivity of human resources within construction projects. The motivation of human resources is argued to be a defining element in the productivity and performance of construction projects (Oyedele 2013). These narratives provide the justification for the importance of incentives as an active motivational tool in the incentivisation process and successful delivery of construction projects.

This paper presents a selection of knowledge, derived from practice and research, on human resource management, motivation, incentivisation and evaluation and how

[1] bolutife.oyemomi@gcu.ac.uk

Oyemomi, B, Hare, B and Tong, M (2016) Exploring Human Resource Incentivisation for Public Sector Construction Project Delivery in Scotland. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, 609-618.

these elements contribute to the achievement of successful project delivery in public sector construction projects in Scotland. Key to this is the sourcing, collection and analyses of individual experience on human resource incentivisation in public sector construction projects in Scotland. The Scottish government, like the UK government, places the construction of infrastructure such as roads, schools, hospitals, houses and so on as an integral component in achieving her socio-economic goals. This significance provides an abundance of construction projects being executed and the opportunity for research is encouraged. This research therefore aims to critically evaluate the types and prevalence of incentive schemes implemented towards the successful delivery of public sector construction projects. Achieving this aim is based on answering the question, how do workforce incentive schemes operate when administered to aid construction project delivery? While numerous literature on human resource incentives exist, the need to contribute to the understanding and knowledge on this subject based on real life individual experience is considerable.

Incentives

The diversity evident in construction projects echoes into the understanding of human resource incentives. Banfield and Kay (2008) defined incentives as the promise and prospect of reward(s) upon the achievement of an agreed outcome. From a financial standpoint, incentives are financial payments received by an employee upon the achievement of previously set goals (Armstrong 2002). The motivational viewpoint defines incentives as the outcomes of the motivational process where the need to achieve specific goals sets up drives intended at motivating the human resource to perform at their highest possible level (Luthans 2005). These definitions provide the criteria for an ideal incentive; specific goals or targets, performance measurement framework, incentive item (financial or otherwise) and the subject of incentives (the human resource).

The incentivisation process requires the implementation of incentives in the form of incentive schemes. The definitions for incentives schemes are a reflection of the understanding of incentives, however for the purpose of this research, these definitions present partial understanding. With individuality highlighted, this research adopts Oyedele's (2013) definition of incentive schemes; a programme that initiates the interaction of social currencies between human resources and the organisations for which they work. This research argues that this singular origin of a social interaction between these parties may manifest in varying forms such as financial, non-financial, rewards, penalties, internal and/or external interpretations. According to Maycock (2009), an incentivised workforce would use performance as a bargaining tool for the highest possible benefit in return. The incentive scheme implemented is the product exchanged for the achievement of the organisational goal thereby satisfying both the sponsor of the incentive and the beneficiary.

Although this research seeks to emphasise a social viewpoint of incentives, the literature review presents the classification of incentives into five main classes, namely; intrinsic, extrinsic, financial, non-financial and disincentive.

Intrinsic incentives

The word 'intrinsic' connotes an inward and naturally occurring origin. This form of incentive is a response to internal behavioural traits exhibited by an employee towards the activity to be performed. These incentives are self-generated and do not require the aid of external factors (Armstrong 2009). Fryer *et al*., (2004), in agreement, stressed that the motivation and incentivisation required for the achievement of any project goal can be derived without the influence of external incentives, for no reason other than the pleasure and pride derived from executing the specific tasks and achieving the required goals. Binderman *et al*., (2000) further stressed that naturally occurring intrinsic reward and incentivisation should be encouraged to thrive within employees and organisations. Intrinsically induced rewards, which are generally

ignored, are argued to act as compensation for poor salaries and job insecurity largely prevalent in the construction industry (Caven and Diop 2012).

Despite the advantages argued in favour of intrinsic incentives, the presented definitions of incentives negate the ideology behind any intrinsic form of incentives. The definitions of incentives connote external influence in the motivational process and any internally originating behaviour would be either a conscious or unconscious response to an external experience. Internal incentives may retrospectively be referred to as external efforts by an incentive sponsor towards an incentive respondent aimed at inciting intrinsically influenced behaviours. This is evident in Armstrong's (2013) assertion; "self-motivated behaviours occur when people take control of situations or relationships, direct the course of events, create and seize opportunities, enjoy challenges, react swiftly and positively to new circumstances and relationships and generally make things happen". These question the legitimacy behind the reality of intrinsically generated behaviours and incentives.

Extrinsic Incentives

Unlike intrinsic incentives, extrinsic incentives connote external origin, influence and occurrence. According to Adedokun *et al*., (2013), these incentives are generated exclusively from the context of the job and largely exist in monetary and material substances. Extrinsic incentives are largely experienced as financial rewards or remunerations, developmental rewards such as learning, training and development, and career progression, and/or social rewards such as performance support, work group affinity, work-life balance and other non-financial benefits. According to Armstrong (2013), although extrinsic incentives seem to provide immediate responses from incentive recipients, these responses may not be long-term. Similarly, Maycock (2009) argued that extrinsic incentives may negatively impact organisational behaviour by preventing the stimulation of intrinsically generated attributes.

Financial Incentives

These are incentives in the form of monetary items such as wages, allowances, financial bonuses and so on (Rose and Manley 2011; Adedokun *et al*., 2013). These incentives are administered in schemes where monetary items are used to reward or penalise individual, team and organisational performance (Chartered Institute of Personnel Development 2014). Regardless of the significant financial attribution to incentives in construction literature and practice, it is argued that these incentives are not the most effective form of incentivisation because they do not inspire recipients to go the extra mile in meeting agreed goals (Armstrong 2013). On a similar note, Maycock (2009) argued that financial incentives have led to a change in occupational psychology from relational to transactional. Binderman *et al*., (2000) further stated that financial incentives have frequently left unfavourable effects on organisational performance. These arguments suggest a move towards non-financial incentives.

Non-Financial Incentives

In direct contrast to financial incentives, these incentives are not generated from monetary items but are derived from programmes such as training and development, flexible work hours, employee engagement and participation and so on (Adedokun *et al*., 2013). According to the Chartered Institute of Personnel Development (2014), this form of incentives is disadvantaged by low level of interest and awareness from the human resource towards it. It is however important to stress the various arguments in favour of this form of human resource incentive. Adedokun *et al*.,

(2013) argued that non-financial incentives have greater impact with recipients due to the memorable and exciting experience recorded. Similarly, Bokhour *et al*., (2006) advocated the adoption of non-financial incentives such as performance monitoring and feedback, system changes and staffing decisions. Furthermore, Banfield and Kay (2008) stressed the need to limit the dependence on financial incentives in favour of an increased emphasis on non-financial items such as work environment, quality of life, flexible working conditions, opportunities for advancement and recognition.

Disincentives

These forms of incentives are derived from penalties, punishments and deterrents. According to Armstrong (2009), disciplinary actions such as withholding pay and criticism are motivational tools that aid human resource performance and eventual project delivery. Meng and Gallagher (2012) stressed the importance to provide a clear demarcation between incentives and disincentives however this does not exclude the possibility of a fusion of these two into an incentivisation programme. This amalgamation provides the likely benefits of identifying and establishing common goals, enhancing healthy collaboration and relationships, and so on (Bower *et al*., 2002). The reviewed literature provides conflicting preferences for incentives and disincentives. Bower *et al*., (2002) argued that regardless of the success record of disincentives, incentives should be given more preference. Contrarily, Bubshait (2003) argued that construction clients have a preference for administering disincentives on defaulting contractors rather than incentives on performing contractors.

RESEARCH APPROACH

This research adopts an interpretivist paradigm which emphasises the viewpoints of the world, truth and reality from the social constructions and interpretations of individuals with personal experience of a particular phenomenon (Fellows and Liu 2008; Silverman 2011; Creswell 2014). The adoption of this paradigm also provides a remedy and substitute to the saturation of positivist and quantitative positions in construction research (Khan 2014; Shipton *et al*., 2014). The saturation of positivist and quantitative viewpoints has largely resulted in an insufficient understanding of the phenomenon of human resource incentivisation; a problem that a qualitative approach sets out to abate (Conklin 2007; Creswell and Clark 2011; Punch 2014). As a form of qualitative approach, this research adopts a phenomenological research design to answer the research questions and achieve the research aim. Furthermore, Silverman (1980) and Gill (2014) affirm that phenomenology seeks to explore, examine and generate an understanding of human experiences on a particular phenomenon.

Data Collection

This research purposively sampled respondents by ensuring that only individuals with experience in human resource incentivisation and project delivery in public sector construction projects in Scotland were engaged as research respondents (Fellows and Liu 2008; Khan 2014). Table 1 provides anonymised details of the research respondents and their roles in the Scottish public construction projects. Individual responses were collected via audio-taped one-on-one semi-structured interviews averaging one hour each based on an interview protocol derived from the reviewed literature, resulting themes and research gaps, while ensuring ethical responsibilities of securing informed consents and assuring research participants of anonymity, privacy and confidentiality (Moustakas 1994; Brinkmann 2008; Preissle 2008). The

interview protocol had five sections: section one covered demographic and career details, section two covered general questions on incentives, section three covered questions on incentives in public construction projects, section four covered questions on incentives in project phases and section five explored the individual experiences of the respondents; all sections featured probing questions.

Table 1: Respondents details and roles

Name	Occupational Role	Employer	Years of Experience
Kennedy	Construction Manager	Public/Private Initiative	13-18 Years
Gabriel	Construction Manager	Private Organisation	19-24 Years
Mark	Construction Manager	Local Council	30 Years and above
Vince	Construction and Project Manager	Local Council	30 Years and above
Clarkson	Development Manager	Local Council	0-2 Years
Sasha	Project Consultant	Private Organisation	8-12 Years
Simon	Project Manager	Private Organisation	8-12 Years
Hammond	Client, Project Manager	Local Council	25-30 Years
John	Project Director	Private Organisation	30 Years and above

RESEARCH FINDINGS

The collected data were transcribed into Microsoft Word and imported into Nvivo10 software to aid the analyses. The findings were coded based on the nodes generated using this software. The findings presented in this paper highlight some of the major themes that summarise the presented experiences of the research respondents.

The interpretation of incentives as corruption

Preliminary findings during the early stages of data collection revealed a defensive stance expressed by potential research participants on the subject of incentives. This personal experience brought enlightenment on the negativity around human resource incentives. The following excerpts provide participant responses to emphasise this theme;

> …when you say the word, it is bribes that comes to mind… [Sasha].

This response may not reveal the factors behind this interpretation, however other responses reveal that with the level of focus on the public sector, public opinions eventually affect individual responses towards public sector programmes such as construction projects. This argument is reinforced in the excerpts below;

> …when people say incentives, they can start thinking of the all brown envelope under the table and things like that. [Hammond].

This interpretation is strengthened by the secretive disposition expressed by some parties within construction projects, Hammond further explains;

> …there's a bit defensiveness because it comes down to the contract you actually use on site as well…if you're in a contract where you simply employ a builder to come in and build your building for a fixed price, it's up to him and behind his closed doors how much he spends to build that project. You're gonna pay him x amount, he can either spend x or he can spend less than x and if he spends less than x he makes profit. And…they're very nervous about declaring exactly how much money they're making off it…from that point of view…they'll keep that close to their chest… no one likes to talk about money obviously …it's just one of these things the contractor will keep quiet about how much they're making.

These interpretations to the word 'incentive' exist in direct contrast to the reviewed literature. This provides room for further research in understanding the reasons and processes behind these interpretations.

The dominance of financial and monetary incentives

The following excerpts from research respondents reveal the significant financial understanding behind the experience of human resource incentives in public sector construction projects.

> …when people say incentive schemes, I will automatically think of money…a lot of people are driven by the financial aspect… [Clarkson].
>
> About incentives, what comes to my mind is money. For private companies, it is about making money… [Gabriel].
>
> …money is the driving force … [Simon].

The narration provided by Gabriel reveals the possibility of a conflict of interests where contractors are employed to execute and deliver public construction projects with private sector financial ideologies that may conflict with public sector organisational practices.

Further excerpts attempt to provide a rationale for these conclusions;

> …the reason you go to work is money. People always wanna get money. [Simon].
>
> The financial cuts have affected the human resources in public sector organisations as there are now little opportunities for employees in public sector organisations so there is a significant migration to private sector construction organisations [Gabriel].

These responses present money as a significant factor in individual socio-economic well-being and the relationships between the public and private organisations in the construction industry.

The need to move beyond financial incentives

The accessed literature and interview responses provide an identity of public construction projects or the construction industry at large saturated with various financial indicators. Within this climate, the call for a re-orientation away from financial incentives is significant.

> Community benefits should be encouraged… Employability is a key community benefit… Individuals on site are financially driven but other non-financial incentives that improve happiness, passion and drive should be emphasised. [Gabriel].

Further excerpts attempt to provide an origin for the responses of individuals towards financial incentives and rewards;

> …as a Christian the bible says…money is the root of all evil…when you tend to go after money, you will lose the purpose of your job…if everybody is depending on incentives to work, that means nobody is gonna work. [Simon].

The above excerpts affirm the impact external factors have on the interpretations of individuals towards incentives and other management tools implemented to achieve organisational and project goals. The role of spirituality in the eventual success or failure of any incentive is evident in this response therefore stressing the need to identify possible factors such as these and manage them to aid project delivery.

Management hierarchy tensions

The literature review presents the distribution of incentives and rewards across the hierarchy within construction organisations and projects. This phenomenon is

identified and interpreted by the research respondents in a manner that stresses that the environment and framework within which human resource incentives are implemented is crucial in the delivery of public construction projects.

> …when I joined the organisation I'm with now, I found it very unusual that there wasn't …any kind of structure in place for salaries, bonuses, anything at all…they could pay me a salary and tell me that it was expected of me but I think it's to do with the non-confrontational management style over the years that it's become traditional in our organisation…if you're not gonna incentivise somebody, you have to cause otherwise they're going home at five o'clock. They've got no incentive to give you extra…if you don't know when you're getting promoted, if you don't know when you're getting a share scheme, if you don't know when you're getting a bonus, if you don't know when you're getting your next raise, you're going home at five o'clock. [Sasha].

While human resource planning, transparency and communication is not emphasised in the literature on workforce incentivisation, this response indicates the importance of the workforce feeling well informed on details of milestones for salary payments, salary increases, rewards and bonuses, promotions and other incentivisation plans.

DISCUSSION

The subject of managing the human resource with motivational tools has for years been tried and tested with varying responses from recipients of these tools. The encounter of the research respondents with financial incentives and rewards, either personally or observational, is a direct reflection of the contents of the literature reviewed. Despite the negative consequences attributed to the application of financial or monetary items as motivational incentives (Binderman *et al*., 2000; Maycock 2009; Armstrong 2013), the continuous implementation of financial incentives and rewards is evident. The adoption of a qualitative phenomenological approach confirms the findings of the largely quantitative research on this subject, however, while most literature advocate for incentives to be objective, measurable, rigid, cost and time oriented and contractual (Bower *et al*., 2002; Rose and Manley 2011), this research argues for a more flexible and psychological oriented approach as proffered by Bokhour *et al*., (2006); Banfield and Kay (2008) and Adedokun *et al*., (2013).

The responses provided also emphasise the impact of the external world on the project environment. This research recognises and emphasises the need to identify the idiosyncratic attributes that individuals bring into the project environment and how these attributes react to both mutual and contradictory positions. The construction workforce is largely presented with predefined policies and processes and do not seem to enjoy an avenue to infuse personal interests into their occupational tasks; further research on this may be necessary to provide a balanced compromise.

While the collected data support a move away from financial incentives and rewards, just as some literature, to other forms of incentivisation such as community benefits, employability and passion for the profession, this situation may not be unconnected to the experience of corruption in general and an absence of transparency from private contractors. This research presents monetary or financial items as a catalyst to the perception of corruption in the incentivisation of the construction human resource. The construction industry in the United Kingdom, characterised by the harmful use of contractors and subcontractors, contract lobbying, cover pricing and the absence of transparency in the tendering process, is considered vulnerable to corrupt practices (Arewa and Farrell 2015) and this situation may be a significant contributor to these experiences of corruption in public construction projects. These arguments provide

room for further research into the validity of these perceptions as corruption and the factors surrounding these interpretations.

While most organisations constantly battle to abate the occurrence and effect of tensions within, the tag of 'public project' and the need for top level individuals to recognise and act on the concerns of tax payers may incite tensions that directly or indirectly impact on the incentivisation experience. This research confirms the absence of an effective plan and structure to incentivise the human resource. The importance of an incentive plan is shared by Bokhour *et al*., (2006); Sparer and Dennerlein (2013) and Mir and Pinnington (2014), who argued for the consideration of the following in this regard: clear definition of targets and goals, performance evaluation, distribution of incentives, the attainability, fairness and competitiveness of the goals, options of incentives and the reactions and attitudes of the human resource towards these incentives. This research recognises these needs and recommends a stronger consideration of these elements in human resource incentivisation not just within public sector projects but across the construction industry.

CONCLUSIONS

The subject of human resource incentives as a human resource management tool has been debated for many years, however, the literature reviewed indicated the circulation of dated knowledge largely based on financial interpretations and rewards. This argument fostered the need for the acquisition and contribution of novel understanding about this phenomenon. While some elements of the literature reviewed were echoed in the data collected, the prospect of contributing to a new path of knowledge and practice is highlighted.

This argument for a novel approach to human resource incentivisation required adopting an unusual path of qualitative phenomenology which emphasised that the experiences of human resources in public sector construction projects are sought, collected and analysed to present the meanings generated from individual experiences. While the process of seeking appropriate respondents and getting relevant accounts with regards to the research subject presented significant levels of challenges either due to the negative interpretation of incentives or the ironic secrecy attached to public sector affairs, the accessed respondents provided an extensive account of experiences. These accounts led to findings on the perception of incentives as corruption, the unsurprising dominance of financial human resource incentives and rewards, the call for a move away from financial incentives and rewards, the need to utilise intrinsic and non-financial incentives, the importance of timely and accurate communication within construction organisations and projects on incentive items and implementation, and the likely tensions between employers and employees on the management approach to employee incentivisation, well-being, motivation and evaluation.

REFERENCES

Adedokun, O A, Ibironke, O T and Olanipekun, A O (2013) Vulnerability of motivation schemes in enhancing site workers productivity for construction industry's sustainability in Nigeria. *International Journal of Sustainable Construction Engineering and Technology*, **4**(1), 21-30.

Al-Tmeemy, S M H M, Abdul-Rahman, H and Harun, Z (2011) Future criteria for success of building projects in Malaysia. *International Journal of Project Management*, **29**(3), 337-348.

Arewa, A O and Farrell, P (2015) The culture of construction organisations: The epitome of institutionalised corruption. *Construction Economics and Building*, **15**(3), 59-71.

Armstrong, M (2002) *Employee Reward 3rd Edition*. London: Chartered Institute of Personnel and Development.

Armstrong, M (2009) *Armstrong's Handbook of Human Resource Management Practice 11th Edition*. London: Kogan Page.

Armstrong, M (2013) *How to Manage People 2nd Edition*. London: Kogan Page.

Banfield, P and Kay, R (2008) *Introduction to Human Resources Management*. New York: Oxford University Press.

Binderman, J, Kilo, C M and Oldham, J (2000) Rethinking incentives. *Journal of Medical Practice Management*, **16**(2), 70-74.

Bokhour, B G, Burgess Jr, J F, Hook, J M, White, B, Berlowitz, D, Guldin, M R, Meterko, M and Young, G J (2006) Incentive implementation in physician practices: A qualitative study of practice executive perspectives on pay for performance. *Medical Care Research and Review*, **63**(1), 73S-95S.

Bower, D, Ashby, G, Gerald, K, and Smyk, W (2002) Incentive mechanisms for project success. *Journal of Management in Engineering*, **18**(1), 37-43.

Brinkmann, S (2008) Interviewing. *In*: L Given (Ed.) *The Sage Encyclopaedia of Qualitative Research Methods*. California: Sage Publications, 471-473.

Bryman, A (2012) *Social Research Methods 4th Edition*. Oxford: Oxford University Press.

Bubshait, A A (2003) Incentive/disincentive contracts and its effect on industrial projects. *International Journal of Project Management*, **21**(1), 63-70.

Chan, A P C and Chan, A P L (2004) Key performance indicators for measuring construction success. *Benchmarking: An International Journal*, **11**(2), 203-221.

Chan, A P C, Scott, D and Chan, A P L (2004) Factors affecting the success of a construction project. *Journal of Construction Engineering and Management*, **130**(1), 153-155.

Chartered Institute of Personnel Development (2014) Bonuses and Incentives. Available from http://www.cipd.co.uk/hr-resources/factsheets/bonuses-incentives.aspx [Accessed 28th May 2014]

Conklin, T A (2007) Method or madness: Phenomenology as knowledge creator. *Journal of Management Inquiry*, **16**(3), 275-287.

Creswell, J W and Clark, V L P (2011) *Designing and Conducting Mixed Methods Research 2nd Edition*. California: Sage Publications.

Creswell, J W (2014) *Research Design: Qualitative, Quantitative and Mixed Methods Approaches 4th Edition*. London: Sage Publications.

De Wit, A (1988) Measurement of project success. *International Journal of Project Management*, **6**(3), 164-170.

Fellows, R and Liu, A (2008) *Research Methods for Construction 3rd Edition*. Oxford: Blackwell Publishing.

Fryer, B, Egbu, C, Ellis, R and Gorse, C (2004) *The Practice of Construction Management 4th Edition*. Oxford: Blackwell Publishing.

Gill, M J (2014) The possibilities of phenomenology for organisational research. *Organisational Research Methods*, **17**(2), 118-137.

Grebler, L and Burns, L S (1982) Construction cycles in the United States since World War II. *Real Estate Economics*, **10**(2), 123-151.

Khan, S N (2014) Qualitative research method: Phenomenology. *Asian Social Science*, **10**(21), 298-310.

Luthans, F (2005) *Organisational Behaviour 10th Edition*. Singapore: The McGraw-Hill Companies.

Maycock, E A (2009) *An Investigation into Performance Based Pay in Nigerian Financial Institutions*, Unpublished PhD Thesis, University of Bedfordshire.

Meng, X and Gallagher, B (2012) The impact of incentive mechanisms on project performance. *International Journal of Project Management*, **30**(3), 352-362.

Mir, F A and Pinnington, A H (2014) Exploring the value of project management: Linking project management performance and project success. *International Journal of Project Management*, **32**(2), 202-217.

Moustakas, C (1994) *Phenomenological Research Methods*. California, CA: Sage Publications.

Oyedele, L O (2013) Analysis of architects' motivating factors in design firms international. *Journal of Project Management*, **31**(3), 342-354.

Preissle, J (2008) Ethics. *In*: L Given (Ed.) *The SAGE encyclopaedia of qualitative research methods*. California: SAGE Publications, 274-278.

Rose, T and Manley, K (2011) Motivation towards financial incentive goals on construction projects. *Journal of Business Research*, **64**(7), 765-773.

Serrador, P and Turner, J R (2014) The relationship between project success and project efficiency. *Procedia-Social and Behaviour Sciences*, **119**, 75-84.

Shipton, C, Hughes, W and Tutt, D (2014) Change management in practice: An ethnographic study of changes to contract requirements on a hospital project. *Construction Management and Economics*. **32**(7-8), 787-803.

Silverman, D (2011) *Interpreting Qualitative Data 4th Edition*. London: SAGE Publications

Silverman, H J (1980) Phenomenology. *Social Research*, **47**(4), 704-720.

Sparer, E H and Dennerlein, J T (2013) Determining safety inspection thresholds for employee incentives programs on construction sites. *Safety Science*, **51**(1), 77-84.

HOW TO CHOOSE A PROJECT MANAGER UNDER UNCERTAINTY

Raquel Cassar[1] and Hector Martin

Civil & Environmental Engineering, University of the West Indies, St Augustine Campus, St Augustine Circular Road, St Augustine, Trinidad

The success of modern construction projects heavily depends on assigned resources, one of the most crucial being the project manager. Project manager selection is a highly critical decision which is complicated because it does not depend on any single attribute but an analysis of several different characteristics of a candidate. This multi-criteria approach which requires the assignment of weights to criteria and candidates introduces uncertainty derived from the subjective judgment of the decision maker(s). This uncertainty amplifies the risk of choosing the wrong person, particularly, when the applicant pool is large and comprised of similarly qualified or experienced candidates. While fuzzy uncertainty has been applied to discriminate among candidates, random uncertainties have been absent from the discourse. Cloud Theory which uses a bell-shaped membership function, and which is an amalgamation of Fuzzy Set Theory and Probability Theory, is used to account for both fuzzy and random uncertainties. A case study on a construction firm illustrates the hiring exercise and details how the preferences of decision makers are applied to the model. This new approach capitalizes on randomness between the fuzzy partitions when the alternatives appear indistinguishable. Such a model can aid human resource managers by simplifying decisions where uncertainty exists.

Keywords: cloud theory, decision-making, human resource, project manager selection

INTRODUCTION

A project manager who lacks the necessary technical, leadership, or managerial skills increases the risk of project failure and can result in overall stakeholder dissatisfaction. The selection of a competent project manager is therefore highly imperative to the accomplishment of a successful project, as they ensure project integration and they also represent the medium between the client and contractor. The associated roles and subsequent importance of the chosen project manager render the decision-making process involved in selecting a project manager as being significant but most complex. The complications manifest themselves as uncertainties in the decision maker(s) thought process when deciding which project manager is most appropriate for a job. There is extensive literature on factors affecting the choice of project managers, but few relating to how one would go about choosing a project manager. In an attempt to reduce this deficiency, academics within the last decade have tried to produce multi-criteria decision models (MCDM) for making this decision. The primary focus of the MCDM's by Afshari and Yusuff (2013), Xing and A-di (2006), and Hadad, Keren, and Laslo (2013) have been related to the application of Fuzzy Set Theory by itself and also as a modification of other models. Fuzzy

[1] riquelcassar@gmail.com

Cassar, R and Martin, H (2016) How to Choose a Project Manager under Uncertainty. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 619-628.

models account for uncertainties that are fuzzy in nature (ambiguous, imprecise, etc.) but does not compensate for random uncertainties. The inclusion of randomness should reduce the risk of choosing the wrong person as low probability outcomes can be accounted for in the modelling process. The suggestion is therefore to move away from Fuzzy Set Theory assignment of a precise value to the membership degree of an element belonging to a qualitative concept (Yang, Yan and Zeng 2013) and the utilization of Cloud theory which overcomes this weakness as it considers the randomness of fuzziness (Cheng et al., 2006).

The Cloud Model first purported by Li, Cheung, and Ng (1998) uses fuzzy set theory integrated with probability theory as the basis for modelling decision making that involves both fuzzy and random uncertainties (Cheng et al., 2006). This model represents a one to many functional mapping. In defining the Cloud model, Li, Cheung, and Ng (1998) acknowledged a stochastic disturbance of the membership degree encircling a determined central value as being more feasible than a precise range of fuzziness. Cloud Theory allows the measurement of the deviation of a random phenomenon from a normal distribution when the phenomenon is not able to wholly satisfy a normal distribution (Wang, Xu and Li 2014). Yang, Yan and Zeng (2013) were of the view that different confidence levels should be used to represent different judgments. Instead of a decision maker expressing a certain confidence level as done by models proposed by Afshari, Yusuff and Derayatifar (2012) and Afshari and Yusuff (2013), the interval judgement will be used to allow the decision maker free reign over their personal confidence level in making a judgment. The Cloud Model along with interval judgement will be used in this paper as a means of modelling uncertainty.

It is debatable whether a purely cognitive decision may suffice for this decision. However, they may become inappropriate even if the premises are true, as often the putative conclusion are not generalizable (Johnson-Laird 1983). Any temporary discrimination between right (good) decisions and wrong (bad) decisions, loses its validity in the chaotic flow of the decision process considered in its wholeness (Dimitrov 1998). Hence, to produce more meaningful results, a more structured approach is required. However, it is contradictory to use models with no account of uncertainty to model a concept which is uncertain (Martin et al., 2016). While fuzzy uncertainties have been accounted for in models developed to select project managers, random uncertainties have been absent from the discourse, as such, the understanding of uncertainty proposed here departs from partial determinism to include variability. To assist with the selection of a project manager, the aim of this research is to develop a computerised model which incorporates both random and fuzzy uncertainties. The objective is therefore to provide the context through which decision-making uncertainty can be incorporated and illustrate the derived approach with a case study. This representation by this work not only provides a wider spectrum of uncertainty that was previously unaccounted for but it also provides a structured, more efficient selection procedure which reduces the risk of poor choice, when recommending the most appropriate person for a project.

LITERATURE REVIEW

The decision problem of choosing a project manager is hierarchical in nature. This structuring allows for a systematic evaluation of the decision problem (Liqin, Wenming, and Yuexian 2009) where at the lowest tier of the hierarchy are the set of managers to be selected and at the next layers above are the set of factors in which all

potential project managers must be compared. At the top of the hierarchy is the most suitable candidate meeting the requirements. Traditional methods for the evaluation and hiring of a new project manager uses an interview panel. In this process, the selection of an individual project leader is based on the panel's perception of the person's competency and their contribution to the success of a similar scale project. The utilization of a group of experts as is conventionally done introduces biases, error, ambiguity, and uncertainty to the process. This fact is supported by Torfi and Rashidi (2011), who stated that the possibility of human error presents itself in every rational decision. Disagreement amongst persons on the choice of a particular individual can also surface in a panel setting (Rashidi, Jazebi and Brilakis 2011). In comparing the qualifications and skills of one Project Manager against another, there exists a vague difference in determining whether one is higher, lower or the same (Liqin, Wenming and Yuexian 2009). They also highlighted that ambiguity between the candidates when weights are assigned to each candidate on each criterion produces vagueness with unclear boundaries especially since all candidates are not exactly alike. The emphasis placed on selecting a suitable project manager and the complicated process involved underscores the need for a system that can simplify and enhance an accurate selection. Where fuzziness exists, it refers to uncertainties about the boundaries of a concept (Yang, Yan and Zeng 2013).

A decision maker's judgment is random, and their knowledge of a candidate may be limited. The variance of these impressions introduces randomness in the decision. Randomness suggests that a concept is perceived differently by different persons or even the same person. It is characterized by repeatability and uncertainty although knowing all possible choices (Li and Du 2007). Ergo, in a case such as the hiring of a project manager where human reasoning takes reign, randomness is inevitably present and contributes to the production of biased decisions. The presence of these elements increases inaccuracies in the decision process (Yang, Yan and Zeng 2013), particularly if they are not accounted for in the decision. A computerized approach to selecting a project manager can aid in simplifying this process. This approach, coupled with an appropriate mathematical principle can eliminate the elements of ambiguity and uncertainty and increase accuracy.

Rashidi, Jazebi, and Brilakis (2011) found that systems using fuzzy set theory as their basis can be used in cases where companies lack experience in selection or the person who possess the necessary expertise are unavailable for the interview. Afshari and Yusuff (2013) modelled the quantitative assessment of project managers through the application of fuzzy linguistic variables. The linguistic judgements were converted into crisp values for the weighting of criteria and the rating of candidates in the form of triangular fuzzy numbers. A fuzzy integral method was used to obtain a final score for candidates. This model was a variation of the one previously done by the same authors, i.e., Afshari, Yusuff, and Derayatifar (2012) in which the evaluation criteria and linguistics were the same, but a simple additive weighting method was used for aggregating the final candidate score.

The type-1 triangular fuzzy model represents a one to one functional mapping of input to output using membership degree between 0 and 1. They, therefore, provide the user with a set confidence level and thus, cannot account for variability in the outcome from the same input data. This approach uses fuzzy set to represent certain and crisp judgments, which is contradictory to the intent of fuzzy set which is to model uncertainty (Saaty and Tran 2007). The type-2 fuzzy set can be applied to solve this deficiency. However, it is equally limited in its account of vagueness as the footprint

of uncertainty region is consecutive, and has a clear boundary. The vagueness of human thinking attributes to decision-makers having difficulty in evaluating an entity with corresponding specific numbers (Wang et al., 2014). In the practical sense, these defined triangular fuzzy numbers do not provide a clear relation to human cognition and the degree of confidence and consistency of a decision made by different persons. These models also neglect the inclusion of a person's confidence in making the decision, which is not in keeping with the essence of fuzziness. Because the selection of a project manager involves evaluation of persons on several criteria, the Analytic Hierarchy Process (AHP) has also been employed for gauging the abilities of candidates by Torfi and Rashidi (2011). This method allows for a pairwise comparison of candidates that expressed the degree of preference of one candidate over another. It consists of a nine-point scale corresponding to comparative verbal judgments ranging from "equally preferred" to "extremely preferred" (Saaty 2008). A ratio is used to depict the strength of the dominance of one candidate over the other. Yang et al., (2013) critiqued this method by stating that the numerical values cannot directly correlate to a verbal judgment because of differences in human perception. Thus, randomness still exists. However, it can be deemed as more effective as opposed to giving an assignment of preference based on overall weighting. The ignorance of uncertainty due to randomness in the models reviewed sparks the need for a model that accounts for this element in the selection process.

Liqin, Wenming and Yuexian (2009) noted that the process of choosing a project manager is one that involves a significant number of evaluation criteria. Studies (Rashidi, Jazebi and Brilakis 2011; Afshari, Yusuff and Derayatifar 2012) show that the selection factors for choosing a project manager consist of personal attributes which are specifically related to the project manager, his experience, and skills required for managing and leading a team. The literature on project manager selection reveals that the majority of the reviewed studies do not provide a systematic method for criteria selection (Chaghooshi, Arab and Dehshiri 2016). In addition, there is no definitive set of criteria for selecting a project manager, particularly, as each project delivery method assigns different roles to the project manager and hence skills required might vary.

CLOUD theory

Intervals eliminate the uncertainty associated with the use of a point value (Martin et al., 2016). Each decision maker is therefore required to supply interval judgement aij = [a_{ij}^{L},a_{ij}^{U}] for the importance of each factor and project manager on each factor, which is a measure of the certainty of some value between upper a_{ij}^{U} and lower a_{ij}^{L} limits. The supply of such judgement is with conviction that the actual value lies within the range supplied; i.e. the uncertainty is small in the cognition of the decision maker (Yang et al., 2013). For this judgement the membership of the median is the largest and the memberships of the values below a_{ij}^{L} and above a_{ij}^{U} are quite small. Therefore, the uncertainty is smallest near the expectation Ex (median) and the two endpoints of the "bell shaped" distribution, but the uncertainty in between them is the largest, and the certainty in these regions is low (Yang et al., 2013). See Figure 1. Using the interval judgement supplied by each decision maker, an interval pairwise comparison reciprocal matrix A = [aij], i, j = 1, 2, ..., n, is constructed for the factors compared against each other and for the project managers compared on each factor.

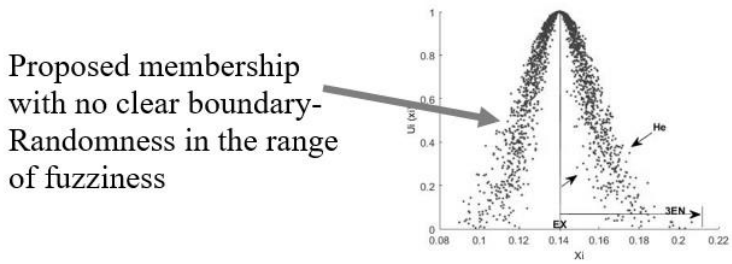


Figure 1: Cloud model characteristics (adopted from Martin et al., 2016)

Since a comparison between two factors is made only once, the symmetrical position, without judgment of the decision makers, are determined as the reciprocal. The diagonal of the matrix a_{ii}, is determined as [1, 1] as each value is compared to itself. The Cloud ratio parameters $\tilde{a}_{ij} = (Ex_{ij}, En_{ij}, He_{ij})$ are defined according to Yang et al., (2013) as follows: Ex expresses the expectation of the interval judgement, the median of the interval can therefore be used to determine its value. See Equation 1.

$$Ex_{ij} = \frac{a_{ij}^{L} + a_{ij}^{U}}{2}$$ …. Equation 1

Interval [Ex-3En, Ex +3En] best represents the confidence of a judgment as near certainty (99.74%, 3 Sigma rule) (Grafarend, 2006). Therefore, 6En can be used to reflect the bound and fuzziness of the interval number. Equation 2 illustrates the Entropy (En) determination.

$$En_{ij} = \frac{a_{ij}^{U} - a_{ij}^{L}}{6}$$ …… Equation 2

The computation of uncertainty parameter Hyper-entropy (He) is based on the context of the judgment matrix, see Equation 3.

$$He_{ij} = \frac{Max\left|En_{ijk} - En_{ij}\right|}{3}$$ ……. Equation 3

Where:

$$En_{ijk} = \frac{\left(a_{ijk}^{U} - a_{ijk}^{L}\right)}{6} \; and \; a_{ijk} = \left[a_{ijk}^{L},\ a_{ijk}^{U}\right] = a_{ik} \otimes a_{kj}, \quad k = 1,2,\ldots,n, \quad k \neq i, k \neq j$$
…. Equation 4

The operator $\otimes$ expresses the fuzzy multiplication of interval numbers, and

$$a_{ijk} = a_{ik} \otimes a_{kj} = \left[a_{ik}^{L}, a_{ik}^{U}\right] \otimes \left[a_{kj}^{L}, a_{kj}^{U}\right] = \left[a_{ik}^{L} a_{kj}^{L}, a_{ik}^{U} a_{kj}^{U}\right]$$ ……. Equation 5

The Cloud parameters in the symmetrical position of a positive reciprocal matrix, without judgment of experts, are determined as $\tilde{A} = \left[\tilde{a}_{ij}\right] = \left[\left(Ex_{ij}, En_{ij}, He_{ij}\right)\right] =$ 1/(Exij,Enij,Heij) (Martin et al., 2016). Where: $\tilde{a}_{ij} = \frac{1}{\tilde{a}_{ji}} \; and \; \tilde{a}_{ii} = (1,0,0)$ as there is no uncertainty when a value is compared to itself. If He and En are zero a constant is obtained. In this sense, certainty becomes a special case of uncertainty. The cloud weights of matrix Ã for each decision maker is given by the geometric mean, as shown in Equation 6.

$$\widetilde{w_i} = \frac{\left(\prod_{j=1}^{n} \tilde{a}_{ij}\right)^{1/n}}{\sum_{i=1}^{n}\left(\prod_{j=i}^{n} \tilde{a}_{ij}\right)^{1/n}}$$ …Equation 6

Parameter "He" also reflects the consistency of the judgment matrix. Thus, the consistency index (CI) of the Cloud matrix is shown in Equation 7. In practice, CI satisfying less than 0.1 (less than 10%), i.e. a 90% confidence is required (Saaty 2008). To avoid the influence of bad opinions, only decision maker's judgement with consistency greater than 0.1 are considered.

$$\mathrm{CI} = \frac{1}{n(n-1)} \sum_{\substack{i,j=1 \\ i \neq j}}^{n} \left(He_{ij} / Ex_{ij} \right) \ldots \ldots \ldots$$

Equation 7

From the equation, individuals with high consistency are rewarded with a high weighting and the converse also holds. See Equation 8.

$$wa_i = (0.1 - \mathrm{CI}_i) / \sum_{i=1}^{m} (0.1 - \mathrm{CI}_i) \ldots \ldots \ldots \text{Equation 1}$$

Equation 8

If the importance Wp is predefined by seniority etc. of the decision makers, the composite weight vector wc is given by Equation 9.

$$wc = \alpha^{wa_i} + (1-\alpha)Wp, \; 0<\alpha<1 \ldots\ldots \text{ Equation 9}$$

Where: α is the proportion assigned to the consistent weight vector. For two clouds C1 (Ex1, En1, He1) and C2 (Ex2, En2, He2) in the same universe of discourse U, they can be aggregated using one of two methods (Yang et al., 2013): Synthetic Cloud Aggregation Algorithm: This approach treats the cloud contributions equally, see Equation 10; and the Weighted Cloud Aggregation Algorithm: this is the weighted average of n number of Clouds, see Equation 11.

$$\begin{cases} Ex_s = \frac{1}{n} \sum_{i=1}^{n} Ex_i \\ En_s = \frac{1}{6} \left[\max_i \{Ex_i + 3En_i\} - \min_j \{Ex_j - 3En_j\} \right] \\ He_s = \frac{1}{n} \sum_{i=1}^{n} He_i \end{cases} \quad \ldots \text{ Equation 10}$$

$$\tilde{A}_{wa} = \frac{\sum_{i=1}^{n} wa_i \tilde{A}_i}{\sum_{i=1}^{n} wa_i} \quad \ldots \text{ Equation 11}$$

Where wai = (wa1, wa2, . . ., wan) represents the weight vector, see equation 12.

$$\tilde{A}_{wa} = \sum_{i=1}^{n} wa_i \tilde{A}_i = \left(\sum_{i=1}^{n} wa_i Ex_i, \sqrt{\sum_{i=1}^{n} (wa_i En_i)^2}, \sqrt{\sum_{i=1}^{n} (wa_i He_i)^2} \right) \quad \ldots \text{ Equation 12}$$

The algorithm and power operations for the interaction of cloud C1 and cloud C2 can be obtained from Li and Du (2007) and Martin et al., (2016). The global weights for the project managers are determined by synthesizing the set of local weights. The global weight for the ith alternative delivery method $\tilde{S}_i$ (by considering all attributes is a Cloud number (Exi; Eni; Hei)) using the weighted score method is:

$$\tilde{S}_i = \sum_{k=1}^{k} \widetilde{w_{ik}} \, \tilde{e}_k \ldots\ldots\ldots \text{ Equation 13}$$

Where $\tilde{e}$ is the final cloud weight vector for factors involved in the decision, and $\widetilde{w_k}$ is the final cloud weight vector of the alternatives compared on the factors. The final score $\tilde{S}_i$. Ranking of the project managers can be done by comparing the Cloud numbers parameters (Yang et al., 2013). For example, if Exi ≥ Exj, Eni < Enj, and Hei < Hej, then project manager Ai absolutely dominates project manager Aj; otherwise, if Exi < Exj, and Eni < Enj or Hei < Hej, we say Aj averagely dominates Ai. Consideration of the uncertainty expressed by En and He is done when Exs are

approximately equal. The generating algorithm of the one-dimension forward normal Cloud for input of uncertainty characteristic Ex, En, and He, and the number of Cloud drops N, the output will be the certainty degrees μ, i.e., drop (xi , μi), for i=1,2,3,..,N (Li and Du 2007). MATLAB modelling was used to express the content of the information model generated as follows:

Beginning with expectation of En and a standard deviation of He, a normal random number En_i' is generated, En_i' = NORMAND (En, He).

A normal random number xi, with expectation of Ex and a standard deviation of En_i' is produced. xi = NORMAND (Ex, En'1).

Calculate the certainty degree of xi, such that $\mu = e^{-\frac{(x_i - Ex)^2}{2(En')^2}}$

xi is a Cloud drop with the confirmation degree μ_i expressed as drop (xi, μ_i).

i–iv is repeated until the Cloud drops generated are sufficient for N.

Plot each drop (xi, μ_i).

METHOD

The case study was designed to elicit both qualitative information about the topic of study and quantitative information to be used for the model. Data was collected via a structured questionnaire with four main sections. The questionnaire was validated by obtaining a professional opinion on its effectiveness. The first section asked respondents about basic information concerning themselves and their experience in the construction industry. The second section provided the respondent with an exercise involving the interval ranking of candidates based on their curriculum vitae, according to specified criteria. The criteria were chosen and adapted based on previous studies done by Rashidi, Jazebi and Brilakis (2011) and Afshari, Yusuff and Derayatifar (2012). For the purpose of this study, the criteria selected were 1) educational background 2) technical background 3) managerial abilities and 4) project track record.

Participants were then asked to assign a weighting to the respective criteria based on their perceived importance of the criteria to the selection process. Respondents were then asked to give their opinion on the effectiveness and usefulness of the proposed system versus the current system used in the final section of the questionnaire. The survey targeted Project Management/ Engineering firms. However, a small sample size of 3 persons (2 directors and a HR manager) was established based upon the limited availability and willingness of persons and also time constraints. Data was collected by administering the questionnaires to three personnel at a small consultancy firm specializing in civil engineering, construction management and project management. The name of the firm has been omitted for anonymity. Prior to the use of the model, the accuracy of the coding was verified through an experimental reproduction of the relative size of four coins, size being the criteria being evaluated. To ensure the evaluations were not by chance both initial and iterated judgements were compared with Kendall's coefficient. A coefficient of 1 indicates complete agreement and 0 indicates no agreement between both judgements. Significance was set at $p \leq 0.05$.

RESULTS

The participant's best guesses for the relative sizes of the four coins were 93.5% accurate and statically reproducible with significance of $P < 0.001$. A correlation of 1 was attained for the Kendall's-Tau. This indicates that the initial judgement and iteration were identical. The cloud model built is therefore verified as being consistently accurate in measuring the subjective judgement of individuals and a group of individuals incorporating uncertainties of fuzziness and randomness. 4x4 matrices representing the four project management (PM1, PM2, PM3, and PM4) compared against each other were obtained for the three decision-makers (P1, P2, and P3) evaluation of each criteria. For brevity only the pairwise comparison matrix and cloud matrix for decision maker #1 on the factor educational background is provided in table 1. The importance of the criteria compared against each other is obtained in a similar manner. Figure 2 illustrates the final ranking as determined by combining all criteria cloud weighting and the weighing of each candidate.

DISCUSSION

The Synthetic weight was used to aggregate all decision makers view on a project manager compared against another on a factor, as this weighting represents an assignment of importance to each decision maker by consistency. The weighted average of all Synthetic weights obtained for each factor was then determined yielding the final cloud weights. This weighted average weight treats each factor as being equally important, as at this stage no importance is given to any of the factors by the group. To determine the importance of the factors against each other the synthetic weight was used; the importance of each decision maker was to consistency of their judgement supplied.

Table 1: Comparison of decision makers on factor Educational Background

	Interval comparison matrix			
Candidates	PM1	PM2	PM3	PM4
PM1	[1,1]	[1.125,1.143]	[1.125,1.143]	[1.500,1.600]
PM2	[0.875,0.889]	[1,1]	[1,1]	[1.333,1.400]
PM3	[0.875,0.889]	[1,1]	[1,1]	[1.333,1.400]
PM4	[0.625,0.667]	[0.714,0.750]	[0.714,0.750]	[1,1]
	Cloud Matrix - CI -0.003			
PM1	[1,0,0]	[1.176,0.009,0.003]	[1.008,0.001,0.007]	[1.374,0.015,0.001]
PM2	[0.856,0.008,0.002]	[1,0,0]	[0.859,0.008,0.002]	[1.178,0.005,0.007]
PM3	[1.003,0.002,0.009]	[1.179,0.011,0.003]	[1,0,0]	[1.365,0.017,0.001]
PM4	[0.734,0.009,0.001]	[0.863,0.003,0.005]	[0.733,0.009,0.001]	[1,0,0]
Weight	[0.279,0.002,0.001]	[0.238,0.002,0.001]	[0.279,0.002,0.001]	[0.204,0.002,0.001]

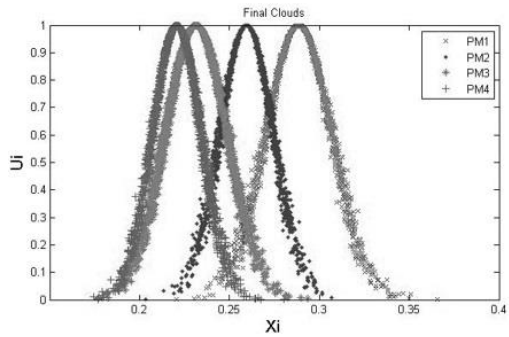


Figure 2: Final Cloud Weights

In combining the weighted average cloud for the comparison of the decision makers and the synthetic weight of each factor the final ranks of candidates was obtained. Using the cloud numbers corresponding to the uncertainty parameters (Ex_{ij}, En_{ij} and He_{ij}) a dominance of the "i" element overpowering the "j." was determined as Exi ≥ Exj, Eni < Enj, and Hei < Hej. As such, PM1 turned out as the highest ranking candidate. The overall ranking in descending order was PM1, PM2, PM3 and PM4. In ranking criteria, Managerial Abilities (MA) was the most important criteria among the four, while Technical Background (TB) was ranked the lowest. In comparing the usefulness, and practical use of the proposed evaluation system to that which currently exists, two out of three practitioners partaking in the questionnaire exercise indicated that the proposed system is more effective at eliminating an undesirable candidate from the process. They also agreed that the system would be a beneficial tool for use in the future. All participants strongly agreed that the system was able to reflect a high degree of certainty in their judgment which was the ultimate aim of this research. One limitation to this research is that there was no existing system for the proposed system to be compared with. Also, the model does not address interpersonal uncertainties which could have been achieved by involving an iteration process, which involves two separate judgments by the same group of persons and improving the consensus on the first judgment. Time constraints and willingness of persons prevented the use of such procedures. The computational process has also shown itself to be quite time consuming, but further exploit in MATLAB computer program may be able to provide further simplification.

CONCLUSIONS

Uncertainty presents itself within most every day and professional decision-making processes due to innate human cognitive processes. Extant models have successfully automated the procedure, but have failed to capture the essence of uncertainty in the form of randomness which exists in the intrapersonal realm and only treat with fuzziness. This research recognized that interpersonal uncertainties are often neglected and this may produce less accurate decisions. Cloud model was shown to be accurate in the representation of a person's judgement with reality. The model built can prove to be quite effective and beneficial to the construction industry, especially in cases where a panel of experts is difficult to conglomerate or when alternatives are indistinguishable. Further work can incorporate the one-iteration Delphi method to improve the judgments of decision-makers, a sensitivity evaluation of the judgement supplied, and an ease of use graphic user interface. This research enlightens a new path for professionals within the construction industry for improving decision-making skills that will ultimately aid in reaping rewards through successful projects supervised by competent project managers.

REFERENCES

Afshari, A R and Yusuff, R M M (2013) Fuzzy integral project manager selection. *Australian Journal of Multi-Disciplinary Engineering*, **9**(2), 149-154.

Afshari, A R, Yusuff, R and Derayatifar, A R (2012) Project manager selection by using fuzzy simple additive weighting method. *In*: R S J Kasim and I Musirin (Eds.) *2012 International Conference on Innovation, Management and Technology Research (ICIMTR)*, 21-22 May 2012, Malacca, Malaysia. IEEE, 412-415.

Chaghooshi, A J, Arab, A and Dehshiri, S J H (2016) A fuzzy hybrid approach for project manager selection. *Decision Science Letters*, 5(3), 447-60.

Cheng, T, Li, Z, Li, D and Li, D (2006) An integrated cloud model for measurement errors and fuzziness *In*: A Riedl, K Wolfgang and G A Elmes (Eds.) *12th International Symposium on Spatial Data Handling 12-14 July 2006*, Vienna, Austria. Heidelberg: Springer, 699-718.

Dimitrov, V (1998) *Decision Emergence out of Complexity and Chaos Semiotics and Complexity* Available from http://members.tripod.com/~Vlad_3_6_7/Decision-Making-in-Complexity.html [Accessed 6th April 2015]

Grafarend, E W (2006) *Linear and Nonlinear Models: Fixed Effects, Random Effects, and Mixed Models*. New York: Walter de Gruyter.

Hadad, Y, Keren, B and Laslo, Z (2013) A decision-making support system module for project manager selection according to past performance. *International Journal of Project Management*, **31**(4), 532-41.

Johnson-Laird, P N (1983) Which comes first: Logic or rationality? *Behavioral and Brain Sciences*, **6**(2), 252.

Li, D Y, Cheung, X M S and Ng, V (1998) Uncertainty reasoning based on cloud models in controllers. *Computers and Mathematics with Applications*, **35**(3), 99-123.

Li, D and Du, Y (2007) *Artificial Intelligence with Uncertainty*. Boca Raton, FL: Chapman and Hall/CRC.

Liqin, Z, Wenming, G and Yuexian, C (2009) The application of fuzzy comprehensive evaluation methods in the selection of a project manager. *In*: *Proceedings of Fourth International Conference on Computer Sciences and Convergence of Information Technology*, 24-26 November 2009, Seoul, South Korea. 1387-1391.

Martin, H, Lewis, T M, Peterson, A and Peters, E J (2016) Cloudy with a chance of fuzzy: Building a multi-criteria uncertainty model for construction project delivery selection ASCE Journal of Computing in Engineering. [In Press, Manuscript #: CPENG-1697R2].

Rashidi, A, Jazebi, F, and Brilakis, I (2011) Neurofuzzy genetic system for selection of construction project managers. *Journal of Construction Engineering and Management*, **137**(1) 17-29.

Saaty, TL (2008) Decision making with the analytical hierarchy process. *International Journal of Services Sciences*, **1**(1), 83-98.

Saaty, T L and Tran, T L (2007) On the invalidity of fuzzifying numerical judgments in the analytical hierarchy process. *Mathematical and Computer Modelling*, **46**(7), 962-975.

Torfi, F and Rashidi, A (2011) Selection of project managers in construction firms using analytic hierarchy process (AHP) and Fuzzy Topsis: A case study. *Journal of Construction in Developing Companies*, **16**(1), 68-89.

Wang, G, Xu, C and Li, D (2014) Generic normal cloud model. *Information Sciences*, **280**(2014), 1-15.

Wang, J, Peng, J, Zhang, H, Liu, T, and Cheng, X (2014) An uncertain linguistic multi-criteria group decision-making method based on a cloud model. *Science and Business Media*, **24**(1), 170-191.

Xing, B, and A-Di, Z (2006) Application of fuzzy analytical hierarchy process in selecting a project manager. *In*: *Proceedings of 2006 International Conference on Management Science and Engineering*, 5-7 October 2006, Lille, France, 1417-1421.

Yang, X, Yan, L and Zeng, L (2013) How to handle uncertainties in AHP: The Cloud Delphi hierarchical analysis. *Information Sciences*, **222**, 384-404.

BARRIERS TO INDIGENOUS ENTERPRISE IN THE AUSTRALIAN CONSTRUCTION INDUSTRY

Martin Loosemore[1] and George Denny-Smith

Built Environment, University of NSW, Kensington, Sydney, NSW 2052, Australia.

Many Indigenous populations around the world face enormous challenges of relatively high unemployment, poor health and integrating into modern society. The Australian government is seeking to address these problems through social procurement initiatives that encourage construction clients and firms to employ Indigenous businesses in their supply chain. The aim is to build supply chains through regulation, which more closely reflect the demographics and social needs of the communities in which they build. However, many barriers to entry exist for Indigenous businesses and through a national survey of Australian Indigenous enterprises it is shown that these include adjusting to unique construction industry cultures and practices, breaking into existing business networks and being under-cut by industry incumbents and competitors when tendering for projects. Compared to non-Indigenous business, they appear to face special difficulties in starting and scaling-up their businesses due to a lack of mentoring, capital and finance.

Keywords: Australia, Indigenous, procurement, social enterprise.

INTRODUCTION

In Australia a person is considered Indigenous if he or she: is of Aboriginal and/or Torres Strait Islander origin; identifies as Aboriginal and/or Torres Strait Islander; and is accepted by an Aboriginal and/or Torres Strait Islander community as being of that decent (Australian Bureau of Statistics 2012). There have been long-standing inequalities in health, life expectancy and employment opportunities between Indigenous and non-Indigenous Australians (Commonwealth Government 2015) and the Australian Government is implementing new social procurement initiatives aimed at increasing opportunities for Indigenous enterprise in the sector.

In Australia, Indigenous businesses are those that are at least 50% owned by an Indigenous person (IPP 2015). Social procurement differs from traditional procurement in being the use of procurement to leverage extra social benefits and create 'social value' in local communities, beyond the simple purchasing of products and services required (Bonwick 2014). For example, in construction projects, social procurement may involve construction companies specifying products on projects which promote fair trade or requiring subcontractors and suppliers to not only deliver traditional products and services but to also provide employment opportunities for social benefit organisations which employ and train disadvantaged and marginalised groups in society such as the homeless, disabled, ex-offenders, ethnic minorities and Indigenous peoples.

[1] m.loosemore@unsw.edu.au

Loosemore, M and Denny-Smith, G (2016) Barriers to Indigenous Enterprise in the Australian Construction Industry. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 629-638.

As Furneaux and Barraket (2014) point out, through social procurement initiatives, governments effectively create a quasi-market for certain types of minority or social purpose business, diversifying their supply chains with the dual goal of maximising both economic and social value. However, research also shows that many social benefit organisations face significant barriers to entry into the industries within which they operate (Kernot and McNeill 2011). Loosemore and Higgon's (2015) recent research into social enterprise in the construction sector shows that they particularly struggle to penetrate the construction industry. However, while there is an emerging body of research into social enterprise in construction, there has been little research into the barriers to entry facing Indigenous businesses, apart for a small number of studies looking at the dominance of multinationals compared to Indigenous companies in developing countries (Saka and Ajayi 2010). It is this context that the aim of this paper is explore the barriers to entry for Indigenous enterprises in the Australian construction sector.

BARRIERS TO ENTRY FOR INDIGENOUS ENTERPRISES

According to Hindle and Moroz (2010), Indigenous business offers new opportunities for governments to address Indigenous social, economic and health problems through Indigenous wealth creation, social advancement and the strengthening of local communities. However, Foley (2003) warns that Indigenous entrepreneurs face more barriers than non-Indigenous entrepreneurs in building a business. Sullivan and Sheffrin (2003) define a barrier to entry as an obstacle that makes it difficult for a business to enter a given market. These barriers may involve access to client and business networks, industry incumbents, switching costs, economies of scale, existing relationships, and industry reputation, experience and knowledge. However, Foley (2003) argues that Indigenous entrepreneurs generally suffer from poorer business experience, education and training, poorer business networks and industry experience and higher levels of racial discrimination and prejudice compared to non-Indigenous entrepreneurs trying to enter a similar market. Wood and Davidson (2011) also highlight other unique barriers to entry such as: alienation from their own Indigenous community; clashes of cultural value sets; access to an appropriate consumer population; lack of Indigenous role models; language barriers; and lack of access to finance due to their indigeneity.

It is generally considered that the construction industry has relatively low barriers to entry (Murray and Smyth 2011; de Valence 2012). For example, the construction industry has a relatively high level of start-ups each year (Anikeef and Sriram 2008). However, there is also considerable evidence that a large number of these new firms fail (Holt 2013; Konno 2015). A recent report by Australian Security and Investments Commission (2014) identified the construction industry as one of Australia's riskiest industries to operate within, consistently having one of the highest insolvency rates of any industry. De Valence (2003) showed that potential barriers to entry into construction include the cost of investment for entry, market power of incumbents, acquisition of technology, skills, access to capital, state of the market, and intensity of the competition.

Gruneberg and Ive (2000) identified economies of scale, supply chains, incumbent cost advantages, private information, contestable markets and client imposed barriers as significant entry barriers to new construction firms. De Valence (2012) analysed these barriers, further refining them in accordance with the nature of the market a firm enters. For example, perfect competition markets generally contain low entry barriers

and entry barriers increase as the market becomes monopolistic, and increases again as it becomes oligopolistic. Cheah and Garvin (2004) presented a new conceptual model for corporate strategy in the construction industry that identified a range of political, social, cultural, economic, industrial and environmental factors that might impact on a decision to enter into the construction industry. Furthermore, Flanagan *et al*.'s (2007) framework for analysing competiveness research in the construction industry suggests that there may be barriers at a project, firm, industry and national level that could affect a firm's decision to enter into the market.

Unlike other countries with significant Indigenous populations like South Africa and Canada, where governments have introduced social procurement policies to encourage the removal of Indigenous barriers to entry, there has been no research into barriers to entry for Indigenous businesses into the Australian construction industry. For example, Ruthensamy (2012) found that South Africa's Preferential Procurement Policy Framework designed to help South African construction enterprises owned by historically-disadvantaged individuals (HDI's), has increased participation and success of HDI-owned construction enterprises in government construction tenders.

However, it was also found that supply side constraints limited their penetration into the market arguing that a strategy of unbundling was needed to provide greater business opportunities for HDI-owned construction enterprises, supported by a better enabling environment to help such companies access the market. Similarly, in Canada, Mah (2014) found that Canada's procurement policies for Aboriginal business have increased the number of Aboriginal firms competing for and obtaining government contracts. However, it also highlighted an over-reliance on the program by Indigenous businesses, inconsistent implementation and success rates across Canada and increasing competition for government contracts which crowded-out Indigenous businesses. Mah (2014) found that to be effective, social procurement policies needed to be supported by complimentary programs that reduce barriers to entry for Indigenous businesses.

METHOD

Undertaking research in the Indigenous arena is challenging, especially for non-Indigenous researchers. For example, the term 'research' often has negative contextual and historical significance for Indigenous people as it is often seen as an extension of "centuries of violation, disrespect, subjectivism, and intolerance" towards their communities (Pidgeon and Cox 2002:96). Over-research in some social sciences, particularly research done without permission, consultation, or involvement of Indigenous people, has generated significant mistrust and animosity amongst Indigenous groups of researchers (Martin and Mirraboopa 2009). Although these harmful practices have generally stopped (Cochran *et al* 2008), the implication is that research is often seen by Indigenous people as another form of racism and colonial monitoring (Holmes *et al* 2002). For these reasons, particular care must be taken to ensure inherent assumptions and guiding research principles do not contribute to increasing the divide of understanding with Indigenous people (Pidgeon and Cox 2002).

Recognising the importance of these social and cultural sensitivities to the validity of the research, this study adopted a constructionist ontology which recognised that our respondents would have different attitudes towards and experiences of doing business in the largely non-Indigenous Australian construction industry (Bryman 2001).

Ontologically, constructivism requires researchers to recognize and respect these experiences which are the result of interactions between different actors in real social contexts (in our case Indigenous entrepreneurs and non-Indigenous construction professionals). This ontology necessitated an interpretivist epistemology that required the researchers to treat our respondents as 'meaning makers' and to engage with them to understand how they interpret their experiences from their own perspective (Yin 2009). Epistemologically, interpretivism is anti-positivist in nature which recognizes that this research cannot be conducted in a laboratory environment, but rather in collaboration with Indigenous stakeholders. It also requires the use of qualitative 'meaning-oriented' methods that provide a depth of insight into our respondent's experiential interpretations (Morse and Richards 2002). To avoid accusations of relativism, we employed both qualitative and quantitative methods (Creswell, 2004). After gaining ethics approval for the research study from a multicultural ethics committee, data were collected via an electronic survey of Australian Indigenous entrepreneurs operating within and outside the construction sector. While it is recognized that surveys are often associated with officialdom and mistrusted by Indigenous respondents and that low literacy rates might mean that some Indigenous respondents may not be able to understand questions asked (Holmes *et al* 2002), an online survey was considered the best way to maximise the response rate across a highly geographically and often remotely spread national Indigenous community.

The literacy problem was not a problem in this research because the target of the survey was Indigenous business owners who were highly educated and all businesses had an on-line presence which enabled the online survey approach to be used effectively. Furthermore, Holmes *et al*. (2002) confirmed that surveys can be used successfully in an Indigenous research space if supported by the Indigenous community and to this end the survey was distributed in partnership with Supply Nation and New South Wales Indigenous Chamber of Commerce - NSWICC (both peak bodies for Indigenous enterprise). Considerable discussions were had with these peak Indigenous Business bodies to ensure that the cultural sensitivities and research protocols noted above were carefully considered and respected. The contact details of the researchers were also provided in case the respondents needed clarification on any questions or if respondents preferred to talk about their experiences rather than complete an anonymous survey. This happened in a number of cases.

The questionnaire was developed into four separate sections based on an extensive literature review of research relating to barriers to entry in mainstream business literature, Indigenous business literature and social enterprise literature both within and outside construction. The first section was used to establish the demographic make-up of respondents, focussing on questions relation to age, experience, business turnover, location, scope of activities, industry sector - construction or non-construction etc. on a nominal scale. The second section of the questionnaire related to entry barriers faced by Indigenous businesses in all sectors. The third section asked questions about respondents' involvement in the construction industry. All questions asked respondents to nominate the barriers they had experienced against a seven point bipolar Likert scale. Open questions were also provided to allow respondents to highlight barriers not covered in the structured survey.

To obtain a representative sample of Indigenous enterprises purposive non-probability sampling was used to select a range of Indigenous enterprise directories from across Australia. Peak Australian Indigenous business bodies, Supply Nation and NSWICC

also distributed the survey to their members. In total, the survey was distributed to 235 Indigenous enterprises with 33 usable responses providing a response rate of 14% (a low response rate for the reasons discussed above). The majority of businesses who took part in the survey were between 1-3 years old (30.6%) and under 5 years old (44.7%). 36.1% of respondents identified themselves as a social enterprise (with an Indigenous mission), while 86.1% identified as an Indigenous business/enterprise. 33% of respondents categorised themselves as hard construction trade services and 33% of respondents had more than 50% of their business in the construction sector.

In analysing the survey data, descriptive statistics were used to show the frequency, mean and standard deviation of respondent characteristics. In order to compare the experiences of each sub-group, a non-parametric Mann-Whitney U test was conducted due to the small sample size in each sub-group. Bryman and Cramer (1990) assert that this test is more powerful than the median test because instead of comparing the number of scores that are above the median for two samples, it compares the number of times a score from one of the samples is ranked higher than a score from the other sample. To highlight any relationships between the entry barriers a Spearman correlation test was also run. The Spearman correlation test was performed due to the low sample size of construction focussed Indigenous enterprises (n=18). This test is relevant since it identifies variables that relate to each other, demonstrating that some barriers may be linked or part of a cumulative effect).

RESULTS AND DISCUSSION

The majority of respondents were in the 36-55 age range (69.4%) with graduate education (56.6%) and most were male (69.4%) with just under 70% having at least ten years' experience, although this did not necessarily reflect the time that their business had been operating. The majority of businesses that took part in the survey were between 1-3 years old (30.6%) and under 5 years old (44.7%). Of the respondents, 36.1% identified themselves as a social enterprise (with an Indigenous mission), while 86.1% identified as an Indigenous business/enterprise. Surprisingly, given the youth of these businesses, the majority of respondents' businesses (66.7%) operate in both metropolitan and regional/country areas and the business turnover was well spread.

This would suggest that these companies are growing fast, raising questions about the challenges and potential risks of scaling-up rapidly across large areas. Seventy-five percent of respondents had some business in the construction industry and 33% of respondents had more than 50% of their business in the construction sector. This shows that the construction sector is a very important source of business for Indigenous businesses. However, the majority have little experience of working in the industry (41.7% had less than three years working in the construction sector). When asked about general barriers to entry in all industries (including construction) the largest barrier was adjusting to an industry's unique practices and cultures (4.97) followed by ability to break into industry networks (4.83) and being undercut by industry competitors (4.33). Negotiating with suppliers was also a significant problem (3.93). A Mann-Whitney U test was undertaken to compare the responses of Indigenous enterprises vs. non-Indigenous enterprises, social enterprises vs. non-social enterprises, and construction businesses vs. non-construction businesses.

The results showed that the majority of comparisons are not significant across the three groups, which indicates that Indigenous businesses experience similar barriers to

entry compared to non-Indigenous businesses. However, the construction Indigenous business groups did differ significantly in accessing finance to start their business and government support than their Indigenous non-construction counterparts ($p = 0.05$ and $p = 0.024$, respectively). Why access to finance is more difficult is unclear but may have something to do with the high risk and insolvency rates of working in construction in general, since the small non-Indigenous sample also experienced the same problems in this area. The perceived relatively low level of government support is also surprising given the existence of many new government social procurement Indigenous procurement policies. However, this finding might indicate that implementation is yet to gain any real traction on the ground and there are several possible reasons for this. The results around specific construction industry barriers to entry by those respondents who had worked in the construction. Several questions that evoked a high mean response: The competitive nature of the construction industry (5.78); industry focus on low prices (5.22); awareness of Indigenous enterprises/social enterprises (5.06); and cost of entry (5.06).

Other significant barriers included: demanding clients (4.61) and; existing supply chains (4.17). Industry competitiveness and cost of entry also have the lowest standard deviation of 0.878 and 0.938 respectively indicating a high level of agreement among respondents. To investigate if there were any relationships between the responses, a Spearman rank correlation coefficient test was carried out. The strongest relation was between respondents' ability to handle large work packages and their ability to achieve economies of scale ($rs = 0.765$, $p = 0.000$). In other words, an ability to achieve economies of scale was important to them being able to tender for the larger work packages which tend to occur in most large construction projects.

Following this, the next two strong relationships were between the perceived eagerness with which companies engaged Indigenous enterprises and being taken seriously by the industry ($rs = 0.740$, $p = 0.000$), and between respondents' ability to tender and the difficulty with which they deal with construction industry regulations ($rs = 0.716$, $p = 0.001$). These results indicate that an understanding of industry regulations and protocols and the resources to be able to comply with them is clearly important to securing work in the construction industry. Finding individual clients that take Indigenous businesses seriously also seems critical to building greater trust across the entire industry.

It is useful to compare the results of this research to the recent findings of Loosemore and Higgon (2015) who investigated, through a number of in-depth case studies, external and internal barriers to entry for mainstream social enterprises that operate in the construction sector. External barriers identified in no particular order included: negative perceptions of social enterprises; rhetorical CSR policies that are not implemented; resistance to change; existing procurement practices; lack of engagement between social enterprises and construction; regulations; client silos; the fragmented nature of the construction industry; and construction industry culture. Internal challenges identified included: size and scope of activities; not having an effective strategy; communicating value-add; not being construction sector savvy; running a small business; resourcing; and forming effective and supportive partnerships to access resources and build scale.

Certainly, there are some significant overlaps with our results suggesting that there are a range of common problems facing Indigenous and non-Indigenous social businesses seeking to enter the construction industry. Securing finance, social capital and

business expertise to grow a business, the construction sector's unique practices and culture, difficulties in breaking into existing supply chains, being undercut by competitors and a focus on price as the main employment criteria are common in both sets of results. However, our results add further to Loosemore and Higgon's (2015) qualitative research by statistically showing the relative significance of these barriers for Indigenous enterprises showing policy-makers that they could especially benefit from start-up assistance to build their business in the form of finance, knowledge about how the construction industry works, early resourcing to overcome high costs of entry and opportunities to compete on a level playing field with industry incumbents. Our results also suggest that partnerships and joint ventures with clients who are genuinely committed to building Indigenous entrepreneurship (not necessarily within their own organisations) and with firms who are successfully operating in the sector will be crucial in addressing these barriers. It is also interesting to compare our results with mainstream social enterprise research. For example, Doherty *et al* (2014) shows that most social enterprises struggle to balance the needs of both beneficiaries and clients. This can easily lead to strategic diversions and mission creep and problems in finding an optimum balance between generation of commercial revenue and creation of social value. However, this issue was not identified as a problem by our respondents, probably because many were not set up as social enterprises but as pure for-profit businesses with a majority of Indigenous owners.

In terms of mainstream barriers to entry research, our findings also support Demsetz's (1982) view that existing brand loyalty acts as a significant barrier to entry for new market entrants. It also supports Bain's (1949) assertion that incumbent organisations will undertake hostile actions to dissuade new entrants from entering a market. Bates' (1995) and Porter's (2008) claim that accessing financial and physical capital and human resources acts as an entry barrier for new firms is also supported by our research. Our results also support Defourny and Nyssens (2008), who found that that social enterprises struggle to compete with for-profit companies. And it also supports Robinson's (2006) finding that building social capital and networking is a major issue in securing work.

However, in contrast to Defourny and Nyssens' (2008), government support does not seem to be a problem for Australian Indigenous enterprises and in contrast to Dean and McMullen's (2007) work, there seems to be high awareness of them. Rather, the problem appears to be the implementation and industry take-up of these initiatives rather than the number of initiatives. In construction, our research also supports the work of de Valence (2003), who showed that the cost of investment for entry, access to capital, and intensity of competition are barriers to the construction industry. De Valence (2003) also proposed that the existing market power of incumbents can deter new entrants into the construction industry.

However, our research does not show that these barriers are peculiar to the construction industry, for Indigenous enterprises at least. Similarly, Warszawski (1996) and Cheah and Garvin (2004) also discuss financial aspects that may act as entry barriers to new firms into construction and this is also supported by our results. The responses regarding the competitive nature of the industry also support the work of Flanagan *et al*. (2007), Warszawski (1996), and those of de Valence (2012). Hardie and Newell (2011) and Cheah and Garvin (2004) who found that regulations within the construction industry had the potential to act as barriers to entry.

CONCLUSIONS

The aim of this paper was explore the barriers to entry for Indigenous enterprises in the Australian construction sector. Through an online survey of 235 Indigenous enterprises which produced 33 usable responses, it has been shown that many of the barriers faced by Indigenous firms outside construction are also faced by the same firms within construction. An analysis between construction firms and non-construction firms revealed that respondents had been through similar experiences regarding general entry barriers. The main barriers were adjusting to unique industry cultures and practices, breaking into networks and building social capital, being under-cut by industry incumbents and competitors, low price driving most procurement decisions and a perceived lack of trust in the ability of Indigenous business to deliver work to the same standards as existing subcontractors. The relatively few differences that did exist appear to relate to starting-up Indigenous businesses and then securing capital and finance to enable them to scale-up and tender for normal work packages at a competitive price.

REFERENCES

Australian Bureau of Statistics (2012) *Report 4726.0 - Information Paper: Perspectives on Aboriginal and Torres Strait Islander Identification in Selected Data Collection Contexts, 2012*. Australian Bureau of Statistics, Canberra, Australia

Australian Security and Investments Commission (2014) *Report 412 Insolvency statistics: External administrators reports (July 2013 to June 2014)*. Australian Security and Investments Commission, Canberra, Australia.

Bain, J S (1949) A Note on Pricing in Monopoly and Oligopoly. *The American Economic Review*, **39**(2), 448-468.

Bates, T (1995) Self-employment across industry groups. *Journal of Business Venturing*, **10**(2), 143-156.

Bonwick, M (2014) *Corporate Social Procurement in Australia: Business Creating Social Value*. Social Traders, Melbourne, Australia.

Cheah, C Y J and Garvin, M J (2004), An open framework for corporate strategy in construction. *Engineering, Construction and Architectural Management*, **11**(3), 176-188.

Cochran, P, Marshall, C A Garcia-Downing, C, Kendall, E, Cook, D, McCubbin, L and Gover, R M (2008) Indigenous ways of knowing: Implications for participatory research and community. *American Journal of Public Health*, **98**(1), 22-27.

Cohen, L and Holliday, M (1982) *Statistics for Social Scientists*. London: Harper and Row.

Commonwealth Government (2015) *Closing the Gap: Prime Ministers Report 2015*. Commonwealth Government, Canberra, Australia.

Creswell J (2004) *Educational Research: Planning, Conducting and Evaluating Qualitative and Quantitative Research*. United States of America: Prentice Hall Publishing, 392-434.

Davies, A and Schon, R (2013) *Bridging the Divide: Social Entrepreneurs and Commissioners On Public Sector Contracting.* London: The Young Foundation.

de Valence, G (2003) Market Structure, barriers to entry and competition in construction markets, knowledge construction. *Proceedings of the Joint International Symposium of CIB Working Commissions: W55, W65 and W107*, Department of Building, National University of Singapore, Singapore, 819-827.

de Valence, G (2012) The significance of barriers to entry in the construction industry. *The Australian Journal of Construction Economics and Building*, **7**(1), 29-36.

Dean, T J and McMullen, J S (2007) Toward a theory of sustainable entrepreneurship: Reducing environmental degradation through entrepreneurial action. *Journal of Business Venturing*, **22**(1), 50-76.

Deenadayalan Ruthensamy, L (2012) *An Examination of the Effectiveness of Preferential Procurement in the South African Construction Industry*. PhD Thesis, University of the Witwatersrand, Johannesburg, South Africa.

Defourny, J and Nyssens, M (2008) Social enterprise in Europe: Recent trends and developments. *Social Enterprise Journal*, **4**(3), 202-228.

Demsetz, H (1982) Barriers to Entry. *The American Economic Review*, **72**(1), 47-57.

Doherty, B, Haugh, H and Lyon, F (2014) Social Enterprises as Hybrid Organizations: A Review and Research Agenda. *International Journal of Management Reviews*. **16**(4), 417–436.

Flanagan, R, Lu, W, Shen, L and Jewell, C (2007) Competitiveness in construction: A critical review of research. *Construction Management and Economics*, **25**(9), 989-1000.

Foley, D (2003) An examination of Indigenous Australian entrepreneurs. *Journal of Developmental Entrepreneurship*, **8**(2), 133-152.

Furneaux, C and Barraket, J (2014) Purchasing social good(s): A definition and typology of social procurement. *Public Money and Management*, **34**(4), 265-272.

Gruneberg, S L and Ive, G J (2000) *The Economics of the Modern Construction Firm*. London: Macmillan.

Hindle, K and Moroz, P (2010) Indigenous entrepreneurship as a research field: Developing a definitional framework from the emerging canon. *International Entrepreneurship and Management Journal*, **6**(4), 357-385.

Holmes, W, Stewart, P, Garrow, A, Anderson, I and Thorpe, L (2002) Researching Aboriginal health: Experience from a study of urban young people's health and well-being. *Social Science and Medicine*, **54**(8) 1267-1279.

Holt, G D (2013) Construction business failure: Conceptual synthesis of causal agents. *Construction Innovation*, **13**(1), 50-76.

IPP (2015) *Indigenous Procurement Policy*. Australian Government, Canberra

Konno, Y (2015) An empirical analysis of the discontinuance of business for start-up contractors and property companies in Japan. *Journal of Financial Management of Property and Construction*, **20**(1), 50-64.

Loosemore, M and Higgon, D (2015) *Social Enterprise in the Construction Industry: Building Better Communities*. London: Routledge.

Mah, E (2014) An Evaluation of Canadas Procurement Policies for Aboriginal Business. *Manitoba Policy Perspectives*, **1**(1), 65-81.

Martin, K and Mirraboopa, B (2009) Ways of knowing, being and doing: A theoretical framework and methods for Indigenous and Indigenist research. *Journal of Australian Studies*, **27**(76), 203-214.

Morse, J and Richards, L (2002) *Readme First for a User's Guide to Qualitative Methods.* London: Sage Publications.

Murray, B and Smyth, H (2011) Franchising in the US remodelling market: growth opportunities and barriers faced by general contractors. *Construction Management and Economics*, **29**(6), 623-634.

Newth, J and Woods, C (2014) Resistance to social entrepreneurship: how context shapes innovation. *Journal of Social Entrepreneurship*, **5**(2), 192-213.

Pidgeon, M and Cox, D G (2002) Researching with Aboriginal peoples: Practices and principles. *Canadian Journal of Native Education*, **26**(2), 96-106.

Porter, E M (2008) The five competitive forces that shape strategy. *Harvard Business Review*, January 2008.

Saka, N and Ajayi, O M (2010) A comparative assessment of incentive scheme between Indigenous and multinational construction contractors in Nigeria. *In*: C Egbu (Ed.) *Proceedings 26th Annual ARCOM Conference, 6-8 September 2010, Leeds, UK*. Association of Researchers in Construction Management, Vol. 1, 583–91.

Sullivan, A and Sheffrin, S M (2003) *Economics: Principles in Action*. Upper Saddle River, New Jersey: Pearson Prentice Hall

Warszawski, A (1996) Strategic Planning in Construction Companies. *Journal of Construction Engineering and Management*, **22**(2), 133-140

Wood, G J and Davidson, M J (2011) A review of male and female Australian Indigenous entrepreneurs. *Gender in Management: An International Journal*, **26**(4), 311-326.

Yin, R K (2009) *Case Study Research: Design and Methods*. Thousand Oaks: Sage Publications.

AN OVERVIEW OF EMOTIONAL INTELLIGENCE RESEARCH IN CONSTRUCTION PROJECT MANAGEMENT: METHODOLOGICAL CONCERNS

Ama Lawani[1]

Aberdeen Business School, Robert Gordon University, Garthdee Road, Aberdeen, AB10 7QB, UK

The aim of this paper is to present an overview of previous studies on Emotional Intelligence (EI) in construction project management. The literature was surveyed to identify and describe the characteristics of previous studies of EI in the construction industry. Research themes and methods are reviewed in order to establish how EI of construction project managers are assessed. The findings indicate that majority of the studies applied a positivist methodology in investigating EI which may cloud the actual perception of the individual and consequently the relevance of the concept. Furthermore, the deficit of any alternative methodology may prevent elucidation of new informative ways to explain EI in a unique context such as construction. The study recommends the exploration of construction professionals' identities through their real life experiences by applying the grounded theory approach in order to better understand how EI can be developed and applied in construction project management.

Keywords: emotional intelligence, professional identity, review

INTRODUCTION

Emotion is described in psychological terms as an individualised, intrapersonal reaction to some stimulus and a socially constituted phenomenon located in the social realm (Fineman 2000). Emotion in the early 1900s was perceived as irrational and unreasonable, likewise management and emotion were viewed as opposites (Hancock and Tyler 2009). However, in recent times, management scholars and practitioners have recognised the significance of emotion and its relevance for successful organisational interrelationships. The social and cultural dimensions of emotion have been suggested as a significant area of study because organisational structures and processes are socially formed and sustained through individual behaviours and actions (Domagalski 1999). Consequently, the concept of EI emerged from organisational behaviour research which has had an unusual significant impact on managerial/ organisational practice (Ashkanasy and Daus 2005).

The construction industry, over time, has embraced several management trends in order to improve the performance of projects. Total Quality Management (TQM), Building Information Modelling (BIM) and Public Private Partnering (PPP) are a few such initiatives aimed at achieving development of the industry. Leadership is progressively being recognised as a fundamental element in construction project management and methods of applying this soft skill in a highly technical environment are constantly debated upon (Toor and Ofori 2008, Griffis and Brown 2003). Due to

[1] a.lawani@rgu.ac.uk

Lawani, A (2016) An Overview of Emotional Intelligence Research in Construction Project Management: Methodological Concerns. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference,* 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 639-648.

the multi-organisation and multi-stakeholder nature of construction projects, multiple objectives and conflicting interests often exist which lead to division in cultural and social aspects, lack of inter professional understanding, and difficulty in coordinating stakeholders (Xue *et al*., 2010).

According to Bygballe *et al*., (2010) one of the reasons for the relevance of long term relationships is the growth of industrialization in construction which led to a shift from construction site activities to in-house management facilities. These challenges enact a high demand on construction project managers' capability to coordinate and control activities and manage different individuals for effective co-ordination of issues relevant to the project process. Due to such demands, initiatives such as relationship management and partnering were created to focus on building alliances between project participants and the ability to manage interpersonal interaction (Bygballe *et al*., 2010, Gadde and Dubois 2010). Consequently, problems of inadequate leadership skills associated with project relationships emerged (Pryke and Smyth 2006) and according to Love *et al*., (2011) current developments in the field of construction project management resulted in a 'switch of lenses' in order to examine both psychological (Project manager) and sociological (Project participants) project elements. Skills such as emotional intelligence (EI) leadership have been suggested as a means of improving project performance in construction (Love *et al*., 2011, Pryke and Smyth 2006).

Emotional Intelligence in Construction

While there are a variety of definitions for Emotional Intelligence (EI), there seems to be a general understanding of the concept: Salovey and Mayer (1989) define EI as a subset of social intelligence and the ability to monitor one's own feelings and that of others, to distinguish among them and to use this information to guide one's thinking and actions. Bar-On explains the EI construct as being concerned with effectively understanding oneself and others, relating properly with people and coping with the immediate environmental demands (Bar-On 1997). From a pragmatic view, EI is defined as knowing and managing our emotions and those of others for improved performance (Mersino 2007). EI is also defined as the capacity for recognizing our own feeling and those of others, for motivating ourselves, and for managing emotions well in both ourselves and others (Goleman 2004). A common factor is an underlying presence of inter relational skills and management of people's actions and behaviour. According to Mischung *et al*., (2015), there have been significant claims about the preciseness of EI in predicting workplace success as various studies show positive correlations between EI and job performance.

Construction is a project based industry comprising various separate industries where participants are usually in diverse organisations and where different level of skill and experience are demonstrated. Effective management in such a context demands for group communication, relational skills and effective leadership skills. Since one usually cannot speak of relationships without referring to emotions, EI is now regarded as a supplement to leadership capabilities. Interestingly, with the expose of EI in construction and the recognition of its relevance, the construction industry is still somewhat unwilling to embrace the concept of EI (Mischung *et al*., 2015).The relevance of EI for a construction project manager (CPM) has been an area of argument. Some researchers contend that the presence of a level of emotion quotient in the different styles of leadership is a significant contribution to project success (Turner and Muller 2010) and on the other hand, others such as Antonakis, Ashkanasy

and Dasborough (2009) contend that an undue well-tuned EI is not necessary for a project manager and it may be left behind in the arena of a project manager's development. Likewise, while a survey by Cao and Fu (2011) highlighted the relevance of team members and project managers EI for team effectiveness in construction organisations, Butler and Chinowsky (2006) reported that construction executives scored low in interpersonal aspects of the EI scale. Despite the claims that the level of EI of construction executives and CPM are at or above average (e.g. Butler and Chinowsky 2006), scholars and practitioners continue to refer to the construction industry as hostile, dominated by authoritative behaviours where it is appropriate to enact anger (Lindebaum and Fielden 2011, Lindebaum and Cassell 2012). Due to the controversies associated with EI, scientific research particularly in a construction context has been minimal; this has demotivated scholars to come up with a theoretical academic framework and methodological standards for exploring EI in a project environment (Antonakis, Ashkanasy and Dasborough 2009).

The predominance of EI in scholarly literature presents a facade that much research has been conducted in construction with regard to the concept. Simply using the phrase 'emotional intelligence' as a search criterion in any browser will produce over a million online results showing the extent of its recognition. Research on Emotional Intelligence leadership in the workplace spans across various fields, but only recently did the concept penetrate construction project management (Love *et al*., 2011). In view of the fact that the role of leadership in achieving construction project goals and the project manager's style of leadership are both crucial factors in determining the outcome of construction projects (Griffis and Brown 2003, Larsson *et al*., 2015), consideration of EI as a leadership skill in construction project management is posited as useful in advancing the concept.

However, the EI concept remains largely unexplored in the construction industry (Pryke *et al*., 2015, Zhang and Fan 2013). The reason for this may be due to the perception of masculinity stereotypes throughout the industry (Loosemore and Galea 2008), the traditional styles of adversary relationships (McLennan and Scott 2002) or the confrontational behaviour and communication style of individuals which hinders effective research in the construction industry (Loosemore 1998).This paper presents an overview of EI in the construction industry in the form of a summary of the methodological approaches used in past studies as a step to uncovering the different perceptions of the value of the concept and as a precursor to exploring how EI can be developed and applied in construction. Against this background, the paper aims to answer the following research question: What methods are used in past studies to investigate EI of Construction Project Managers and why were they used? The objectives include: To provide an overview of papers published on Emotional Intelligence of project managers in construction and to provide indication for future direction of study in the area of Emotional Intelligence of Construction Project Managers.

METHOD

An overview of past studies on emotional intelligence in a construction context was conducted through an extensive search of published literature. An overview is typically a narrative summary of literature that attempts to reassess the literature and describe its characteristics. It may be a systematic overview or not, depending on the rigour of search conducted, therefore, it is used for various types of reviews with varying degree of 'systematicity' (Grant and Booth 2009). The population of interest

for this study is the construction industry. Therefore, the search was restricted to studies of EI conducted only in a construction environment. Keywords used in the search included: ‘emotional intelligence’ or ‘emotion’ appearing in the abstract. Terms used in filtering were it was suitable to do so include: ‘construction industry’, ‘construction project management’ and/or ‘construction management’. Since the research on EI is sometimes undertaken from an alternate perspective such as leadership styles, this was also included in the search terms. In addition, extra time was taken to read through the references of the final articles that were identified from the search process.

For this study, the search was comprehensively carried out across 3 construction /engineering databases and 2 journals outside the construction field. The databases used were ARCOM, ICONDA and ASCE. The ARCOM database contains about 19 Construction Management journals, recent ARCOM conference proceedings and PhD theses. The online repository of International Construction Database (ICONDA) contains CIB publications which cover all fields in building and construction research and American Society of Civil Engineers (ASCE) contain articles in peer-reviewed journals and conference proceedings from the American society of civil engineers. Leadership theory underpins EI, therefore other keywords such as 'Leadership styles' and 'Construction management' were used in combination with the keyword 'emotional intelligence' in the literature search. As a result, the search extended to the Leadership Quarterly Journal and Human Relation Journal. These amount of journals were accessed so as to obtain the breath of studies of EI in the Construction Industry. Data was extracted and analysed deductively. Since, the diverseness of focus of management studies prevents the aggregation and assessment of results (Tranfield *et al* 2003), synthesis was achieved by drawing similarity and differences from the characteristics of the gathered studies through interpretative means.

Table 1 describes the process by which articles were selected. 3 databases (containing several journals each) and 2 journals were used in the search. 384 citations were retrieved from the search using keywords 'emotional intelligence', leadership styles and the phrase 'emotional intelligence in construction management’. The keyword 'Emotional Intelligence' yielded 243 articles, 'Leadership styles' yielded 52 articles, the phrase 'Emotional Intelligence in Construction Management yielded 89 articles, each in total, across the 5 sources. Only the ASCE library had provision for applying filters such as 'Construction management and Construction Industry', which resulted in 184 articles being filtered out. The total articles for the review reduced to 200. An abstract review on the remaining articles further excluded 180 articles. Criteria for exclusion included a non-construction context, no actual association with emotional intelligence or a thesis. Consequently 20 articles were fully assessed. During the final review 4 additional articles were identified from going through referenced papers and these were added to the 20 initially identified articles. The review process used in the study attempts to provide an explicit report of the knowledge on methods used in past studies to investigate EI of Construction professionals and the rationale for those methods.

FINDINGS

The final assessment included a total of 24 articles indicating that there have not been many studies exploring the nature of emotional intelligence of professionals in the construction industry. The relatively low amount of articles that was retrieved for the study is comparable with the low number of studies (49) that investigated leadership

in the construction industry (Toor and Ofori 2008) and Clarke's (2010) identification of only 5 studies that specifically examined EI in a project context. Existing studies of EI in the construction industry are circumscribed around investigating the level of EI of an individual/ organisation or the relationship between various personality or leadership types on EI. The studies on EI in construction have explored areas including leadership styles (Butler and Chinowsky 2006, Cao and Fu 2011, Sunindijo 2012), project performance (Love *et al.*, 2011, Zhang and Fan 2013), construction management educational programmes (Mo *et al*., 2007, Mischung *et al*., 2015) and the contracting area (Songer and Walker 2004). Project tasks/stages that have been studied in relation to EI include safety management tasks (Sunindijo and Zou 2013), risk taking (Tixier *et al*., 2014), Conflict resolutions (Sunindijo and Hadikusumo 2013), Cognitive and Relational tasks (Lindebaum and Jordan 2012) and Negotiation stage (Der Foo *et al*., 2004).

Table 1. Article selection process

	ICONDA CIB Library	Leadership Quarterly	Human Relation	ASCE Library	ARCOM	Total
Using keyword : Emotional Intelligence	5			227	11	243
Using keyword : Leadership styles	10	30			12	52
Using key phrase: Emotional Intelligence in construction project management		45	44			89
Apply filters : Construction management and construction industry				-184		-184
Total	15	75	44	43	23	200
Exclusion through abstract interview (non construction context)	-13	-75	- 43	- 37	-12	-180
Retrieved for full review	2	0	1	6	11	20

These studies tend to adopt a particular research approach and most of them focused on exploring the correlation to leadership types. Cao and Fu (2011) and Mo *et al* (2006) opine that since EI correlates with transformational leadership, it may be useful to construction project managers. Similarly, Butler and Chinowsky (2006) showed a relationship between EI and transformational leadership behaviours. Although, no empirical research was conducted, Love *et al*., (2011) and Mo, Dainty and Price (2006) acknowledged the importance of EI and recommended that the concept of organisational behaviour and an individual's EI be explored as well as ways of providing trainings on EI. In line with these suggestions, Mo *et al*.'s (2007) investigation, however, revealed a weak correlation between educational courses and EI of construction students. Their finding suggests that the weak dependence of EI on educational courses could be as a result of the sort of educational programmes taught or other factors. Although, the experimental study by Mischung *et al*., (2015) showed that training construction students in EI skills enable teams to perform better in student work group, nevertheless, this may not be a true representation of real life experiences, where the performance of construction professionals is likely assessed against confrontational beliefs (Loosemore and Gala 2008). Apart from those research which established correlations between EI and leadership behaviour, others investigated the impact of a project manager's EI on certain tasks and revealed a positive correlation with certain conflict resolution style while considering the socio cultural custom (Sunindijo and Hadikusumo 2013). On the other hand another study showed that individuals with a negative emotional state perceived considerably more

risk than those with a positive emotional state (Tixier *et al*., 2014). In spite of these recognitions and suggestions, some authors argue on the negligence of context and tasks in studies of EI (Lindebaum and Jordan 2012).

The specific context of construction often tends to be ignored, as much of the literature concerning EI in construction is based on the traditionally deductive positivist approach. Observed findings resonate with Phua (2013) assertion that human, cultural and psychological factors are paid little attention in the construction literature. Majority of the researchers adopted a quantitative approach focusing at the individual or organisational level. However, at both levels, the aim was mainly to determine the impact of EI on certain personality type variables (e.g. transformational leadership) or organisational variables (e.g. performance). The studies often used questionnaires – self report scaled instrument to establish relationships or the level of influence between variables. The current study identified only two articles that employed qualitative measures in their investigation. One of the them assessed the use and application of EI within the construction industry by employing narratives as a means of organizing data (Lindebaum and Cassell 2012) while the other study qualitatively investigated the behaviour of the individual in a construction context with regards to a specific emotion – anger (Lindebaum and Fielden 2011). For a majority of the studies, dimensions of EI seemed to have a positive correlation or effect on the inquired variable while some authors interpreted their results from a perspective of cultural dimensions of the country in which the study was conducted (e.g. Sunindijo and Hadikusumo 2013). The findings of the current study reflect the preference of research in construction towards a positivist paradigm (Phua 2013, Ofori and Toor 2009). Consequently, the view that the construction industry has been populated by positivist methodologies is deduced from this review, therefore, arguably the knowledge and development of a social construct such as EI may be underrated, specifically in the area of applicability and development of the concept.

DISCUSSION AND CONCLUSION

In general, only a small number of studies use qualitative methods to examine and explain the nature of leadership in the construction industry (Toor and Ofori, 2008). The relatively low number of articles identified in the current study not only throws light on the fact that individual and psychological factors still receive relatively less interest in the construction literature but the findings reveal on over reliance of quantitative methods used in investigating EI. The construction industry has been represented as a social system (Love *et al*., 2002) and emotional intelligence originates from the psychology domain which is a function of the social process embedded in a social system. Conversely, the method of analyses for studying such social processes may not be sufficient, and according to Fineman (2004) the use of quantitative approaches to investigate a social constructed phenomenon undervalues the development of that phenomenon. In addition, surveys and questionnaires mainly measure an individual's perception towards an action or behaviour and not the actual behaviour because of social desirability (Ofori and Toor 2009). Arguably, this implies that majority of past investigations have only made an attempt in finding out the views of construction professionals towards emotional intelligence and not what is actually practiced or what behaviour ‘works’ in their environment with regards to EI. Besides, it was identified that the authoritative style of leadership is significantly used in Turkish construction industry (Giritli and Oraz 2004).The lack of qualitative enquiry of EI in construction, questions how the concept can be thoroughly explored for developmental and applicability purposes. The concept of EI seems to challenge the

way construction project managers understand their identity (Lindebaum and Cassell 2012), this uniqueness or character is often imposed by the nature or circumstance in which these individuals find themselves (Webb 2006).Too often, the focus has been on quantifying the level of EI and establishing relationships between variables such as leadership styles, while neglecting the identity of the individual's understanding with respect to their role and specific context.

Identity is an individual-level construct associated with organisational performance. It is a sense making structure in which individuals interpret themselves and others while interacting with their social environment (Ybema *et al*., 2009). According to Gluch (2009) the role and identity of industry professionals are social constructs shaped through social processes of interaction between individuals and the organisation's milieu. In other words, the work environment has an effect on an individual's attribute which in turn shapes organisational behaviour. Phua (2013) opines that what people say and do are often refined and shaped within organisational and managerial contexts which can be accessed through narratives. The male dominated culture of the construction industry (Loosemore and Gala 2008) impacts on how EI is being interpreted and poses a threat to the identity of CPMs. Accordingly, most CPM believes that EI may have no place in the construction industry leading to low acceptance of the EI concept. As male professionals prefer to hold onto a more technical oriented identity (Faulkner 2007), the objective of applying EI for effective relationship management in construction (Pryke and Smyth 2006) should not precede a clear understanding of the situational and structured realties of how certain conducts are displayed for effective performance.

As Smyth 2000 quoted in Lindebaum and Fielden (2011) states:

> The management style of many contracting companies is based upon the street fighting man. Banter and joking are usually at the expense of others..... verbal abuses are the weapons to instil fear and maintain power...

Construction professionals develop different identities in order to deal with the pressure between their official roles and project practice standards (Gluch 2009). However, the majority of the research conducted on EI in the construction industry do not adequately consider these realities. A focus on establishing correlations, exploring levels of EI in different aspects and/or investigating dimensions of other constructs in relation to EI may prevent the revealing of the dynamics of EI and the complexities of the social process that transpire among individuals in construction. Finally, Mischung and Perrenoud (2015) suggested that educating and assessing individuals in the EI construct may not be successful because of the lack of effectively teaching one how to implement the skill and recognising when it is appropriate to utilise it. In other words, having an awareness of EI or being emotionally competent will not guarantee improved performance. Exploring the individual’s identity and in relation to the work environment will help in explaining how the environment or context creates identities of construction professional and how EI skills can be utilized for meaningful improvements.

Grounded theory often used in studying human behaviour is suggested as a relevant and appropriate approach to studying EI in context of construction as it aims to generate inference which is grounded in the data. The use of qualitative methods of investigation such as in-depth interviews, action research and discursive approaches will illuminate the character and behaviour within the context of the construction industry in relation to EI, will support better understanding of the concept in

construction and consequently discover the usefulness and applicability of the concept.

To conclude, this study fills an important gap in existing construction project management literature by identifying an over use of quantitative research approach in investigating emotional intelligence among construction professionals. This study offers suggestion on employing the use of qualitative approach to investigating EI in the construction industry. Qualitative methods will be useful in revealing the implication of Emotional Intelligence on the identity of construction professionals and vice versa. Albeit, the use of statistical measures provides objective and evidenced results, rich interpretations of contextual features which are relevant in understanding and advancing the concept of EI leadership is absent due to the lack of using alternative research methods such as the Grounded theory approach. As a result, the identity and actual behaviours based on real life practices has a large tendency of being overlooked.

REFERENCES

Antonakis, J, Ashkanasy, N M and Dasborough, M T (2009) Does leadership need emotional intelligence? *The Leadership Quarterly*, **20**(2), 247-261.

Ashkanasy, N M and Daus, C S (2005) Rumours of the death of emotional intelligence in organizational behavior are vastly exaggerated. Journal of Organizational Behavior, **26**(4), 441-452.

Bar-on, R (1997) *The Emotional Quotient Inventory (EQ-i): A Test Of Emotional Intelligence*. Toronto: Multi-Health System.

Butler, C J and Chinowsky, P S (2006) Emotional intelligence and leadership behavior in construction executives. *Journal of Management in Engineering*, **22**(3), 119-125.

Bygballe, L E, Jahre, M and Swärd, A (2010) Partnering relationships in construction: A literature review. *Journal of Purchasing and Supply Management*, **16**(4), 239-253.

Cao, J, Fu, Y and Fu, Z (2011) The relationship between emotional intelligence and transformational leadership behavior of project managers in construction project. *International Journal of Digital Content Technology and its Applications*, **5**(12), 166-170.

Clarke, N (2010) Emotional intelligence and its relationship to transformational leadership and key project manager competences. *Project Management Journal*, **41**(2), 5-20.

Der Foo, M, Anger Elfenbein, H, Hoon Tan, H and Chuan Aik, V (2004) Emotional intelligence and negotiation: The tension between creating and claiming value. *International Journal of Conflict Management*, **15**(4), 411-429.

Domagalski, T A (1999) Emotion in organizations: Main currents. *Human Relations*, **52**(6), 833-852.

Faulkner, W (2007) Nuts and bolts and people' Gender-troubled engineering identities. *Social Studies of Science*, **37**(3), 331-356

Fineman, S (2004) Getting the measure of emotion and the cautionary tale of emotional intelligence. *Human Relations*, **57**(6), 719-740.

Gadde, L and Dubois, A (2010) Partnering in the construction industry: Problems and opportunities. *Journal of Purchasing and Supply Management*, **16**(4), 254-263.

Gluch, P (2009) Unfolding roles and identities of professionals in construction projects: Exploring the informality of practices. *Construction Management and Economics*, **27**(10), 959-968.

Goleman, D (2004) *Emotional Intelligence and Working with Emotional Intelligence*. London: Bloomsburg Publishing.

Grant, M.J. and Booth, A (2009) A typology of reviews: an analysis of 14 review types and associated methodologies. *Health Information & Libraries Journal*, **26**(2), 91-108.

Griffis, F and Brown, N (2003) Leadership in the management of construction. Construction Research Congress, *Winds of Change: Integration and Innovation in Construction, Proceedings of the Congress*, 19th March - 21st March, Honolulu, HI: United States, 559-568.

Giritli, H and Oraz, G T (2004) Leadership styles: some evidence from the Turkish construction industry. *Construction Management and Economics*, **22**(3), 253-262.

Hancock, P. and Tyler, M (2009) Emotion at work. *In*: T Redman and A Wilkinson (Eds.) *Contemporary Human Resource Management*. London: Prentice Hall.

Larsson, J, Eriksson, P E, Olofsson, T and Simonsson, P (2015) Leadership in civil engineering: Effects of project managers' leadership styles on project performance. *Journal of Management in Engineering*, **31**(6), 04015011.

Lindebaum, D and Fielden, S (2011) 'It's good to be angry': Enacting anger in construction project management to achieve perceived leader effectiveness. *Human Relations*, **64**(3), 437-458.

Lindebaum, D and Jordan, P J (2012) Relevant but exaggerated: The effects of emotional intelligence on project manager performance in construction. *Construction Management and Economics*, **30**(7), 575-583.

Lindebaum, D and Cassell, C (2012) A contradiction in terms? Making sense of emotional intelligence in a construction management environment. *British Journal of Management*, **23**(1), 65-79.

Livesey, P (2013) *What Does It Take To Manage Larger Construction Projects: The Role Of Emotional Intelligence, Reflection-in-Action and Autoethnography*. Australian Institute of Project Management, National Conference. AIPM.

Loosemore, M and Galea, N (2008) Genderlect and conflict in the Australian construction industry. *Construction Management and Economics*, **26**(2), 125-135.

Loosemore, M (1998) The methodological challenges posed by the confrontational nature of the construction industry. *Engineering, Construction and Architectural Management*, **5**(3), 285-293.

Love, P E D, Holt, G D, Shen, L Y, Li, H and Irani, Z (2002) Using systems dynamics to better understand change and rework in construction project management systems. *International Journal of Project Management*, **20**(6), 425-436.

Love, P, Edwards, D and Wood, E (2011) Loosening the Gordian knot: The role of emotional intelligence in construction. *Engineering, Construction and Architectural Management*, **18**(1), 50-65.

McLennan, A and Scott, G (2002) Relationships in project delivery. *Civil Contractors Federation 2002 Annual Conference*, 5 October 2002, Hamilton Island, Australia. Civil Contractors Federation.

Mersino, C (2007) *Emotional Intelligence For Project Managers: The People Skills You Need To Achieve Outstanding Results*. New York, NY: Amacom.

Mischung, J, J, Smithwick, J B, Sullivan, K T and Perrenoud, A J (2015) .Using skills based emotional intelligence training to improve team performance in construction management programs. *Proceedings of the 122nd ASEE Annual Conference and Exposition*, 14-17 June 2015. WA: Seattle

Mo, Y, Dainty, A and Price, A (2007) An assessment of the emotional intelligence of construction students: An empirical investigation. *In*: D Boyd (Ed.) *Proceedings 23rd Annual ARCOM Conference*, 3-5 September 2007, Belfast, UK. Association of Researchers in Construction Management, Vol. 1, 325–34.

Müller, R and Turner, R (2010) Leadership competency profiles of successful project managers. *International Journal of Project Management*, **28**(5), 437-448.

Ofori, G. and Toor, S (2009) Research on cross-cultural leadership and management in construction: A review and directions for future research. *Construction Management and Economics*, **27**(2), 119-133

Phua, F T (2013) Construction management research at the individual level of analysis: Current status, gaps and future directions. *Construction Management and Economics*, **31**(2), 167-179.

Pryke, S D and Smyth, H J (2006) *Management of Complex Projects: A Relationship Approach*. Blackwell: Oxford

Pryke, S, Lunic, D and Badi, S (2015) The effect of leader emotional intelligence on leader–follower chemistry: A study of construction project managers. *Construction Management and Economics*, **33**(8), 603-624.

Salovey, P and Mayer, J D (1989) Emotional intelligence. *Imagination, Cognition and Personality*, **9**(3), 185-211.

Songer, A D and Walker, B (2004) Central contractor emotional intelligence in the construction industry. *In*: F Khosrowshahi (Ed.) *Proceedings 20th Annual ARCOM Conference*, 1-3 September 2004, Edinburgh, UK. Association of Researchers in Construction Management, Vol. 1, 487-93.

Sunindijo, R Y and Hadikusumo, B H (2013) Emotional intelligence for managing conflicts in the sociocultural norms of the Thai construction industry. *Journal of Management in Engineering*, **30**(6), 04014025.

Sunindijo, R (2012) Integrating emotional intelligence, political skill, and transformational leadership in construction. *Civil Engineering Dimension*, **14**(3), 182-189.

Tixier, A J, Hallowell, M R, Albert, A, Van Boven, L and Kleiner, B M (2014) Psychological antecedents of risk-taking behavior in construction. *Journal of Construction Engineering and Management*, **140**(11), 04014052.

Toor, S and Ofori, G (2008) Taking leadership research into future: A review of empirical studies and new directions for research. *Engineering, Construction and Architectural Management*, **15**(4), 352-371.

Tranfield, D, Denyer, D and Smart, P (2003) Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British Journal of Management*, **14**(3), 207-222.

Webb, J (2006) *Organisations, Identities and the Self*. London: Palgrave Macmillan.

Xue, X, Shen, Q and Ren, Z (2010) Critical review of collaborative working in construction projects: Business environment and human behaviors. *Journal of Management in Engineering*, **26**(4), 196-208.

Ybema, S, Keenoy, T, Oswick, C, Beverungen, A, Ellis, N and Sabelis, I (2009) Articulating identities. *Human Relations*, **62**(3), 299-322.

Zhang, L and Fan, W (2013) Improving performance of construction projects: A project manager's emotional intelligence approach. *Engineering, Construction and Architectural Management*, **20**(2), 195-207.

HOW HAPPY ARE PROJECT MANAGERS IN THEIR JOBS?

Qingbin Cui[1], Jocelyn S Davis and Hongyi Huang

Department of Civil and Environmental Engineering, University of Maryland, 1173 Glenn L. Martin Hall, 4298 Campus Drive, College Park, MD 20742, USA

Employers and researchers have focused over the last several decades on how to sustainably improve employee performance. Antecedents of happiness at work including employee satisfaction, work engagement, employee engagement, wellness and well-being or happiness have been demonstrated to correlate positively to improvements in key performance outcomes including: employee retention and attendance profitability, productivity, customer loyalty, health, creativity, safety environment, losses to theft, etc. Projects have increasingly been used by organizations in all sectors and industries to deliver significant strategic change initiatives. Project management techniques have improved project success rates, but there is room for further improvement. This study explores the level of self-reported happiness at work for project managers using the Happiness@Work survey and the elements of happiness at work which are most positively correlated with happiness at work for project managers. Preliminary results show PM's happiness is in the bottom 50% against the U.S. benchmark for this survey with effects of total work experience, gender, age, and employment status on overall happiness at work for project managers. Role, team well-managed, organization well managed, meaning of work, and some personal factors (health, happiness, vitality, and confidence) and the level of project management maturity at the organizational level show significant positive effects on overall happiness at work. At the component level of happiness at work (personal resources, organizational system, functioning at work, experience of work), significant differences were noted relative to sector, gender, role, age, time at organization, work experience, stage in the project management process maturity model, and expectations of success of current project.

Keywords: subjective well-being, happiness at work, maturity model, statistical analysis

INTRODUCTION

Recently countries and companies have been moving to measure the happiness of their citizens and their employees. Best place to work indices have proliferated and companies are increasingly striving to be an employer of choice as the competition to attract and retain highly qualified employees increases with the retirement of the Boomer generation. Researchers have reported that happiness or its essential components is linked with reduced morbidity, increased longevity, less symptoms of ill health; positive emotions with increased resilience, motivation, task persistence, creativity, information processing and memory as well as goal attainment. It is not a surprise to see a happier employee is more productive (Oswald et al 2009). Job satisfaction and organization commitment are negatively related to intention to quit, actual turnover, absence from work, poor employee behavior. Improved job

[1] cui@umd.edu

Cui, Q, Davis, J S and Huang, H (2016) How Happy Are Project Managers In Their Jobs? *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 649-656.

satisfaction is positively related to reductions in mental health issues and burnout (Fisher 2009). Each of these benefits which are linked to happiness at work or its components are likely to be of benefit to the project management outcomes as well in all sectors and industries.

So far, however, the literature has not focused on project managers as a profession and whether happiness at work might result in better project outcomes. This paper reports on our findings from a pilot study conducted via online survey in the fall of 2014. We solicited responses from 400 PM professionals attending an annual PMI chapter educational event in Montgomery County, Maryland. We received completed responses from 225 project managers. All participants in this study received a report of their own happiness at work results and then attended a debriefing held at the chapter educational event.

DEFINITION OF WORKPLACE HAPPINESS

Happiness is comprised of two types in the literature: hedonic and eudaimonic views of happiness. In the first instance, hedonic, happiness is seen as an abiding sense of satisfaction with life by the individual considering the overall and domain specific life experiences (Ryan and Deci 2001; Ryff and Singer 2008). Life satisfaction is accompanied in the hedonic view of happiness by a net positive emotional experience over time, meaning that the individual experiences more positive than negative emotions in their life (Diener et al 1999). Happiness in this sense concerns "what benefits a person, is good for her, makes her better off, serves her interests, or is desirable for her for her sake" (Haybron 2011).

The second view of happiness, the eudaimonic view, is concerned with the individual living a good life in a virtuous or moral sense, being true to themselves, acting morally, doing meaningful activities and growing as a person. Seligman (2002) combines these two view of happiness into one, noting that hedonic happiness, while necessary, is limited by genetic inheritance and subject to the hedonic treadmill (highs and lows of hedonic happiness are transitory). He postulates that hedonic happiness is insufficient and authentic happiness is derived by the partnering of hedonic and eudaimonic happiness which is not limited by genetically inherited predispositions to the experience of pleasant emotions and which is unlimited in the experience of eudaimonia through work that is congruent with the self-actualization of the individual, attainment of important self-set goals, and contributing to the greater good.

Happiness at work is conceptualized as transient, person and unit level (Fisher 2009). Transient happiness-related constructs include: transitory affect and mood as well as state affect, flow, mood, engagement, task engagement, and intrinsic motivation. Person level happiness includes physical and emotional health, engagement, job involvement, job satisfaction, and personality-based predispositions. At the unit level, happiness at work includes group level engagement, morale, satisfaction, emotional tone and mood. Happiness at work is the result of the individual, the work, the social environment (the team and the organization as a whole) (McNulty 2012).

HAPPINESS SURVEY AND SAMPLE

The standard questionnaire from HappinessWorks (Marks, 2011) was used as the basis for this survey because it addresses the key elements of hedonic and eudaimonic happiness and the three levels of happiness related constructs at work: transient, person and unit levels. The questionnaire includes 40 questions grouped into four interrelated categories: personal resources, organizational system, functioning at work,

and experience of work. This survey is completed by respondents using a 7-point Likert Scale and data is indexed on a 0 to 10 scale where 5 is the average. Index scores are developed by extensive data analysis of each question to the benchmark survey data. The 40 questions are aggregated without weighting into 16 subdomains and then into four domains or categories which are then combined to yield the overall happiness at work score. Within the standard 40-question survey is one question which asks respondents to rate their happiness at work. Information about the standard questionnaire is available at the HappinessWorks website (http://www.happinessworks.com/).

The standard questionnaire was modified to include expanded demographic filters including: years of work experience, stage of project management process maturity model (PM2), project role, project organization type, industry and sector. Several supplemental survey questions were added: availability and use of alternative work schedules, trusted by manager, and expectations of current project's success.

The sample was obtained by providing an online survey link to registered participants at an educational event sponsored by a chapter of the Project Management Institute, PMI, in October 2014 in Montgomery County, Maryland, a suburb of Washington, D.C. There were approximately 400 registered participants and 227 responses were obtained; two were deleted as outliers prior to analysis of the sample. Respondents were rewarded with their personal results compared to the U.S. benchmark immediately upon completion of the survey and all participants attended a debriefing of the results at the event.

Our sample was nearly equally divided between male and female respondents. The majority of the respondents, 90.75%, were between the ages of 35 and 64 with a similar percentage reporting they were employed full-time. Time at organization was well distributed with 22.91% with 2 years or less tenure with their current organization and 27.31% with 2-5 years, 19.38% with 5-10 years, and 20.70% with 10-20 years. The respondents, while many were new to their organizations, reported significant overall work experience with less than 3% having less than 10 years of work experience and 53.74% with more than 25 years of work experience; 25.15% had 10-20 years of work experience and 17.62% had 20-25. The respondents were well distributed across the various stages of the PM2 model with 23.19% in ad hoc or planned stages, 45.37% in managed stage, and 37.09% in integrated or sustained stages. Project roles of respondents ranged from entry level to PMO director with concentrations in subject matter expert roles, project manager, senior project manager and program manager roles. Project organization (pure project, functional, matrix) of respondents was dominated by matrix organizations at 58.15% with pure project and functional at 19.38% and 22.47%, respectively. Fourteen industries were identified with IT products and services and consultancy dominating. Private sector organizations accounted for 64.32% of respondents; public sector with 20.51% and only 6.17% from not for profit sector.

WORKPLACE HAPPINESS FOR PROJECT MANAGERS

Reliability of Self-reporting of Workplace Happiness

Within the standard 40-question survey, one question asks respondents to assess their happiness at work. The analysis began with evaluating the relationship between the single question self-report of PM happiness at work and the calculated PM happiness at work. Overall PM happiness at work was 5.16 while responses to the single

question was lower at 4.7422 (Figure 1). This difference is significant; however, the overall happiness score and the single question happiness score are highly correlated. The difference between these two happiness at work scores supports the use of the full 40-question survey for assessing PM happiness at work. The difference between these two scores was not found to have a strong positive correlation with demographic characteristics of the respondents based on our initial review.

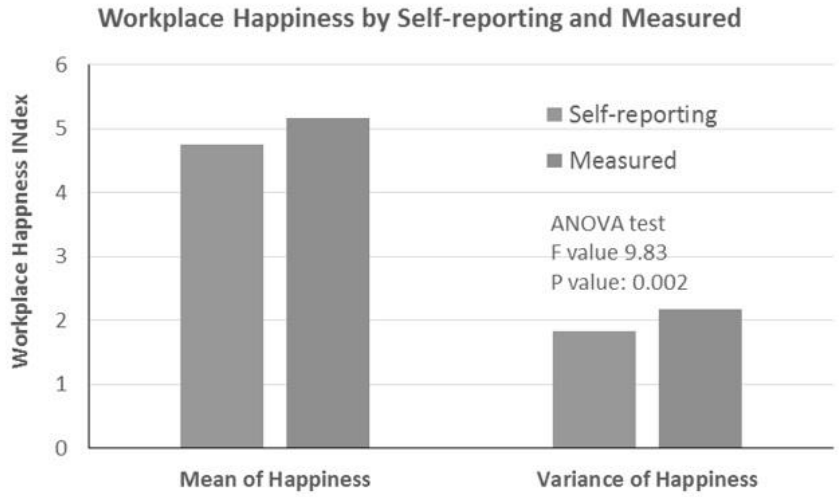


Figure 1: Self-reported vs measured happiness at work

However, in performing a linear regression analysis to explain the driver behind the self-reporting bias, career prospects and free to be self were found to account for nearly half of the observed variance (Table 1). A positive constant indicates an optimism bias on workplace happiness without any impact of factors. Two factors, career prospects and free to be self, help project managers to reduce the optimism bias.

Table 1: Factors affecting cognitive bias in happiness self-report

Indicators	Coefficient	t-statistics
(Constant)	1.094	5.440
Career Prospects	-.126	-3.769
Free to Be Self	-.196	-5.534
Number of cases	225	
R Square	0.215	
F value	30.423	

Overall PM Happiness at Work

The overall workplace happiness score for the 225 total respondents was reported at 5.15, with a standard deviation of 1.47, placing PM's on the average line of the U.S. population per the survey benchmark. Furthermore, significant differences were found in happiness at work for specific subsets of the sample respondents. These are discussed later below.

The overall PM happiness at work scores were correlated with a number of the demographic characteristics of the sample. Gender, age, work experience, employment status, sector, role, PM project management process maturity model (PM2) stage and organization type were analysed for their effect on PM happiness at

work. Gender, age, years of work experience, employment status were not found to be positively correlated with PM happiness at work overall for this sample. However, role, PM2 stage and project organization type were found to have statistically significant correlations with reported overall PM happiness at work. Results are summarized in Table 2.

Table 2: Demographic factors affecting PM happiness at work

Description	Pearson Correlation	P-value
Gender	-	0.158
Age	-	0.440
Work Experience	-	0.342
Employment Status (full or part-time)	-	0.424
Role (task…PM…PMO)	.215**	0.002
PM2 Stage	.181**	0.006
Project Organization Type	.148*	0.026

Note: 1. Sample Size = 225
2. * significant at the 0.05 level (2-tailed)
3. ** significant at the 0.01 level (2-tailed)

Overall PM Happiness at Work by Sector

Our sample did not include sufficient responses from the not-for-profit sector to support a comparison with the private and public sector results. The public sector results were significantly higher for overall happiness at 5.33 compared to 5.10 for the private sector as shown in Figure 2. Data for the private sector separated respondents working for closely held companies and those working for publicly traded private sector companies. Results for these two groups were 5.26 and 4.92, respectively. Not-for-profit results, reporting from a small number of respondents, was 5.14.

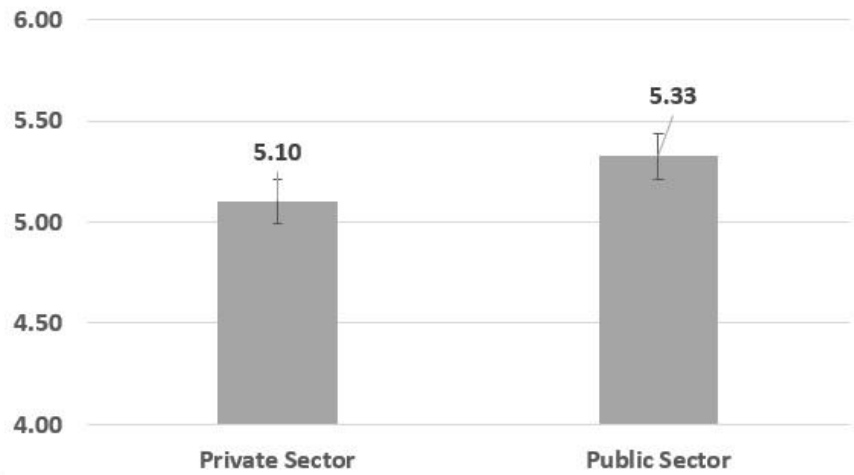


Figure 2: Overall PM happiness at work by sector

The unexpected outcome of public sector PM's reporting higher overall happiness at work than private sector PM's resulted in further exploration of overall happiness by considering possible differences at the category level as a first exploration of what might be contributing to these reported differences. Overall PM happiness at work is developed by aggregating responses in four categories: personal resources, organizational system, functioning at work and experience of work. The favourable overall results for PM happiness at work in the public sector was consistent across all four categories (See Figure 3 below). It is interesting, and a somewhat unexpected

finding, to note that PM's report higher levels of happiness overall and relative to the four component categories for the public sector.

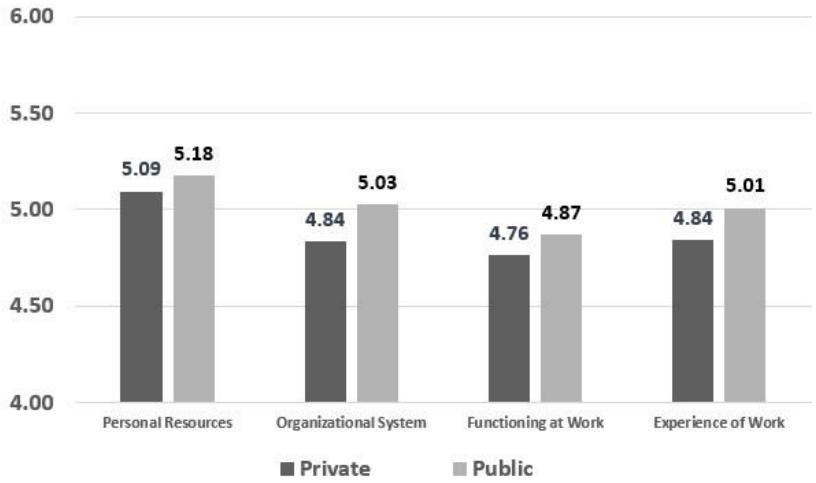


Figure 3: PM happiness at work by category by sector

Exploration of the data for personal resources indicated that the public and private sectors enjoyed modest differences in three of the four subcategories: vitality, happiness, and confidence. Work-life balance was significantly higher for the public sector respondents.

Organization systems category showed very similar results for the public and private sectors for management system but the private sector was below public sector for job design, work environment, and social value. Within the management system subcategory, public sector exceeded private sector PM happiness at work for constructive feedback and team well-managed while the private sector reported stronger results for trusted by manager and organization well-managed. On job design, the public sector results were higher for two of three elements of this subcategory: fair pay and job security while roughly equivalent for achievable job.

Functioning at work, a proxy for intrinsic motivation, showed the sectors with roughly equivalent results for free to be self, with public sector reporting higher scores for use strengths and creativity. Work relationships showed favourable results for the public sector for good friends at work and team relationships with the private sector showing better results for cooperation between teams. The sectors reported roughly equivalent results for relationship with manager. Sense of control and sense of progress were not analysed.

Experience of work shows the public sector with better results for positive emotions and worthwhile work while reporting roughly equivalent results for negative emotions and engaging work.

Project Manager Happiness at Work by Category

At the category level, PM happiness at work showed significant differences for several subsets of respondents.

Gender Differences. Significant gender differences were noted within the four component categories. Females reported higher levels of personal resources when compared with males, but were lower for each of the three other categories. Functioning at work, essentially intrinsic motivation, was the lowest for females at 4.64.

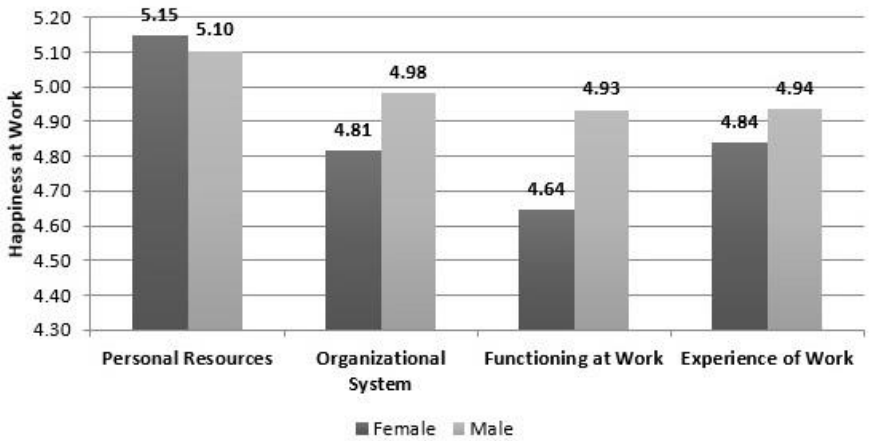


Figure 4: PM happiness at work by category by gender

Although most demographic variables show insignificant impact on the overall workplace happiness, at the category level, age, time at organization, and current project expectations of success showed significant positive relationships for all four categories. PM2 stage showed significant positive relationships for personal resources, functioning at work and experience of work. Work experience showed significant positive relationships only for functioning at work and experience of work (Table 3).

Table 3: Factors positively correlated with PM workplace happiness by category

Description/P-value	Personal Resources	Organizational System	Functioning at Work	Experience of Work
Age	2.85E-36	1.57E-21	1.29E-15	5.21E-20
Time at Organization	9.11E-37	5.28E-67	0.003808	1.57E-87
PM2 Stage	7.94E-85	Insignificant	1.03E-81	0.001256
Current Success Expectations	4E-135	1.7E-111	1.04E-98	8.3E-107
Work Experience	Insignificant	Insignificant	0.0038	0.0453

CONCLUSION

PM happiness at work is on average against the U.S. benchmark for the Happiness@Work survey tool used in this exploratory study suggesting that there is need and opportunity to enhance PM workplace happiness as a pathway to enhanced project performance over time. Distinct differences were found in overall PM happiness at work between the public and private sector with the public sector, somewhat surprisingly, reporting higher PM happiness at work scores. Further exploration of the areas of stronger public sector results and investigation of the underlying causes may lead to development of suggested interventions for the private and possibly not for profit sectors. Areas where the private sector reported stronger results should also be further explored to identify successful practices supporting PM happiness at work.

Overall PM happiness at work was further analysed into its four component categories: personal resources, organizational system, functioning at work and experience of work. Each of these categories, when considered at a sector level reported significant differences in many of the subcategories. This further supports the need and opportunity for further exploration of best practices in each sector to develop and disseminate enabling practices to enhance PM happiness at work.

Demographic differences within the sample examined also resulted in significant differences, some at the overall level and some only at the category level. Further analysis of these demographic differences is needed to assess how best to intervene for organizations, teams and individuals to enhance PM happiness at work. Clearly, one size is unlikely to fit all.

REFERENCES

Amabile, T, and Kramer, S (2011) Do happier people work harder. *New York Times*, Sep 3.

Boehm, J K, and Lyubomirsky, S (2008) Does happiness promote career success? *Journal of Career Assessment*, **16**(1), 101-116

United States Department of Labour (2008) Bureau of Labor Statistics, *Job Openings and Labor Turnover Survey News Release*. March 12, 2008.

Campbell, A, Converse, P E, and Rodgers, W L (1976) *The Quality of American Life: Perceptions, Evaluations, and Satisfactions*. Russell Sage Foundation. Available from https://www.russellsage.org/publications/quality-american-life

Diener, E, Suh, E M, Lucas, R E, and Smith, H L (1999) Subjective well-being: Three decades of progress. *Psychological Bulletin, 125*(2), 276-302 doi:10.1037/0033-2909.125.2.276

Edmans, A (2012) The link between job satisfaction and firm value, with implications for corporate social responsibility. *The Academy of Management Perspectives*, **26**(4), 1-19.

Ferguson, W J and Kessler, T R (2009) *The People Agenda: Top Strategic and Operational Issues Facing the Architectural, Engineering and Construction Industries*. FPL Advisory Group, Chicago, Illinois.

Fisher, C D (2009) Happiness at work international. *Journal of Management Reviews*, **12**(4), 384-412. doi:10.1111/j.1468-2370.2009.00270.x

Freeman, R B (1977) *Job Satisfaction as an Economic Variable*. The National Bureau of Economic Research Working Paper No. 225.

Haybron, D (2011) Happiness. *In*: N Edward (Ed.) *The Stanford Encyclopaedia of Philosophy*. Available from http://plato.stanford.edu/archives/fall2011/entries/happiness/

Marks, N (2011) *The Happiness Manifesto: How Nations and People Can Nurture Well-Being*. TED Books.

Myers, D G and Diener, E (1995) Who is happy? *Psychological Science*, **6**(1), 10-19.

Oswald, A J and Proto, E and Sgroi, D (2009) *Happiness and Productivity*. IZA Discussion Paper No 4645. Available from SSRN: http://ssrn.com/abstract=1526075

Pryce-Jones, J (2011) *Happiness at Work: Maximizing Your Psychological Capital for Success*. Hoboken, NJ, John Wiley & Sons.

Ryan, R M and Deci, E L (2001) On happiness and human potentials: A review of research on hedonic and eudaimonic well-being. *Annual Review of Psychology*, **52**(1), 141-166.

Ryff, C D, and Singer, B H (2013) Know thyself and become what you are: A eudaimonic approach to psychological well-being. *In*: A D Fave (Ed.) *The Exploration of Happiness: Present and Future Perspectives*. London: Springer Dordrecht, 97-116. doi:10.1007/978-94-007-5702-8_6

"TAKE CARE OF THIS HOUSE" - AFFECTS MATTER IN CONSTRUCTION INNOVATION

Chloé Vitry[1], Dan Sage[2] and Andrew Dainty[3]

[1&2] *School of Business and Economics, Loughborough University, Epinal Way, Loughborough, Leicestershire, LE11 3TU, UK*

[3] *Civil and Building Engineering, Loughborough University, Epinal Way, Loughborough, Leicestershire, LE11 3TU, UK*

Discussion of affects and emotions remains notably absent within studies of innovation, not least in construction. Most innovation studies in construction adopt a rationalist approach where innovation implementation is a function of cost-benefit calculations and deliberative management support. Even in those studies that do consider innovation as the result of complex interactions between people, ideas and technologies, such as those inspired by Actor-Network Theory (ANT), it is often presumed that the network builder is a rationally calculative actor. However, a growing body of research across the social sciences, including the margins of ANT, has shown that innovation is shaped by emotions and affects. To examine these themes our research addresses an experimental zero-carbon housing project to show how innovation implementation is influenced by a rich affective tapestry of love, pride, hope, fear, greed and annoyance. Understanding such affects, and their socio-material conditions and power relations, may help us further address the complexities of innovation implementation.

Keywords: innovation, emotion and affect, materiality sustainable construction

I was given a visit, by the site manager - I will call him Bob, of a construction site for a zero-carbon housing (ZCH) development, to investigate the success of innovation implementation on this project. From what I'd been told by the project manager, the development, a complex project using multiple innovations to lower carbon emissions in use, had been considered very successful by the company, as well as by the government. Little did I know how special this site was. The site itself announced it: the site manager's NHBC 'Pride in the Job award' was displayed at the site entrance, next to his picture, for all workers and visitors to see. Entering the site office, I was once again reminded of it through the dozens of similar awards covering the wall from top to bottom - all in his name. Then, as we walked on the tour, I started to get a sense of what 'Pride in the Job' might mean. While Bob was explaining the ways different innovations were integrated in the houses, I witnessed him pick up trash on the ground and dispose of it in the appropriate bin; check that one innovation he was showing us - AirTape™ - was correctly applied to the window frames, without bubbles; inspect a door and phone someone to ask them to come and get it cleaned; interrupt two subcontractors to discuss an issue with wardrobe installations in another unit; spot another worker from afar and ask him for an update on his work; inspect another person's work and ask him to make sure the nails were fitted properly;

[1] C.vitry@lboro.ac.uk

Vitry, C, Sage, D and Dainty, A (2016) "Take Care of This House" - Affects Matter in Construction Innovation. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 657-666.

comment with humour on the damp, crumpled state of a professional drawing a worker was holding. While we were visiting a finished house being cleaned before delivery, I saw him wipe dust off a faucet, and re-tick a grey-water label on which the ink had faded. All these small acts, witnessed over a one hour period, made me wonder about the role such a level of care on the construction site, and pride in his job, could have on making innovations work in a complex environment.

INTRODUCTION

Most studies on innovations in the construction industry, and elsewhere, adopt a rationalist approach where the emotional and affective dimensions of innovation implementation are not discussed at all or glossed over (Drejer and Lund Vinding, 2006; Dubois and Gadde, 2002; Hartmann, 2006; Dulaimi, Ling and Bajracharya, 2003; Gambatese and Hallowell, 2011; Gajendran *et al*., 2014). And yet, the relevance of emotions on the construction industry has been acknowledged, not just in terms of employee wellbeing (Haynes and Love, 2004), but also the role of emotions in achieving project success (Dainty *et al*., 2005). Beyond construction, emotions have been shown to play a key role in innovation, whether enabling future innovative projects (Shepherd and Kuratko, 2009) or firm creativity (Amabile *et al*., 2005; Baron and Tank, 2011). Moreover, sociological studies of innovations in construction, while not focusing on emotions, stress the importance of moving beyond seamlessly rationalistic and linear control approaches to innovation implementation to engage with the "messy, complex and dynamic realities of construction activity" (Harty, 2008:1038). Such an approach is crucial if we want to move beyond a sanitized view of innovation as a rational, linear activity, which offers very little purchase for practitioners looking for relatable insights into their practice. While Harty and others (e.g. Linderoth, 2010) advocate Actor-Network Theory (ANT) to apprehend the complexities of construction innovation, classic variants of ANT (e.g. Callon, 1984) struggle to address how innovations travel across more fluid contexts. This said, some ANT studies have shown that technologies can be successful because they can be adapted rather than stabilised in advance of their implementation. Notably, these studies have suggested that this adaptability is accompanied by a 'love' for or 'care' of the innovation (De Laet and Mol, 2000; Latour, 1996).

Our purpose in this paper is to explore the significance of this affective life in innovation through the example of housebuilding, specifically a 'zero carbon' pilot project. This paper is organized into three sections. First, we discuss the predominance and limitations of rationalist approaches to construction innovation. Then we introduce innovation studies that have addressed emotions and affect, before considering the potential for ANT studies of construction in particular to address emotions and affect as part of the messy socio-technical process of innovation implementation. Finally, we empirically elaborate on the potential of our approach through an analysis of the role emotions and affect in construction innovation.

Beyond A Rationalist Approach to Construction Innovation

Innovation studies tend to assume (and produce) a calculative, cognitive, rationalist human subject. These studies attribute the shortcomings or successes of innovations in the construction industry variously to management activities (Drejer and Lund Vinding, 2006), organizational structures (Dubois and Gadde, 2002), and environmental variables (Hartmann, 2006). Studies that do mention less determinate human behaviours, such as motivation, tend to rationalise them into 'expected goals' and 'main objectives' (Dulaimi, Ling and Bajracharya, 2003). Even as innovation

studies have registered socially complex humans as shaping innovation implementation, these accounts focus on the deliberate calculations and rational cognitions, mostly of senior managers (Gajendran *et al*., 2014; Gambatese and Hallowell, 2011).

In short, the role of emotions and affects remains underplayed in most cited studies on innovation in construction, indeed more widely innovation studies possess a "unidimensional focus on the rational aspects of human behavior" (Choi *et al*., 2011:108). And yet, studies have shown how understanding and processing strong emotions - such as the grief of a failed project - can improve the outcome of future innovative projects (Shepherd and Kuratko, 2009). Equally, positive affects has been linked with creativity, in turn impacting organizational innovation (Amabile *et al*., 2005; Baron and Tank, 2011). Paralleling these nascent theories of affect and innovation, sociological studies, especially those mobilizing ANT (e.g. Harty, 2008; Linderoth, 2010) have challenged the idea that the uptake of innovation is a function of their innate viability or efficacy, but rather dependent on complex social-material negotiations.

Consider the installation of an innovative Photovoltaic (PV) panel on a house. ANT suggests that for this technology to produce a predictable amount of electricity given a certain amount of sunlight (to be considered a 'successful' innovation), a network has to be organized, comprised of other actors defined, enrolled and aligned towards this goal. These actors include humans - engineers, contractors, end-users, planners, policymakers - and non-human actors - the sun, planning policies, overhanging trees, the internal electricity circuit, and feed-in tariffs. This process where actors and their interests are defined and aligned constitutes an 'actor-network' - PV - whose predictable agency is the result of its relations. PV thus becomes capable of being implemented on multiple sites, a technology in which the relations between actors that render it mobile and successful are folded inside this predictable 'black boxed' actor (Latour, 1987).

A 'blackboxed' innovation, like PV, can travel across space and time, or be successfully 'implemented'/'used' elsewhere, as long as its network holds firm not because it is rationally judged as useful, - the actor-network is "only as strong as its weakest link" (Latour, 1987:121). ANT is thus suggestive of a significant problem within the context of construction innovation: some of the critical actors involved in implementing innovations remain incredibly difficult to known or enrol in advance, using the sort of calculative, even Machiavellian, network building techniques described by Callon (1984) and Latour (1987). For example, Latour (1987) discusses how one can align the goals of actors by asking them to make a detour through your technology in order to pursue their own goals. However, in the case of construction - sub-contractor fragmentation, the ephemeral nature of projects, and the practical challenge of management monitoring on site - renders attempts to fully know in advance let alone control the panoply of actors (sub-contractors, suppliers) involved in innovation implementation, via mechanisms such as goal alignment, and accompanying surveillance and bureaucratic control, highly problematic (Green, 2006; Thiel, 2013).

And yet innovations, even those that are highly disruptive, clearly do sometimes still travel across building projects and are successfully implemented. Some ANT studies of innovation are suggestive of the idea that emotions and affects may be significant conduits for processes of enrolment in such uncertain domains. De Laet and Mol

(2000) offer the example of a bush pump used in rural Zimbabwe. They show that the long-term success of the innovation to travel through time and space corresponds with the fluidity, rather than stability of its network, such that the handle, for example, can be replaced by a piece of wood. This fluidity is said to mediate the care and love circulating among the actors involved with the pump, which "must seduce people into taking care of it" (De Laet and Mol, 2000: 235). Similarly, the failure of innovations to travel can be attributed to lack of love and care: Latour (1996) uses ANT to explain how ARAMIS, the abandoned personal rapid transport system in Paris in the 1980s, never came to fruition. For him, the key element to ARAMIS' demise was the assumed maturity of the innovation, which for Latour is indicative of a lack of love for innovation research: "you still don't love research. Its uncertainties, its whirlwinds, its mixed character, its setbacks, its negotiations, its compromises" (Latour 1996: 293). Despite these affective ruminations, these ANT studies of innovation fail to develop a conceptualisation of the relationship between affect and innovation. In the next section we will begin to develop the potential for theories of affect, especially those influenced by work within the social sciences (e.g. Anderson, 2014; Hardt and Negri, 2000; Massumi, 2002), which have much in common with ANT to help elaborate the significance of affective life to ANT, and other sociological, studies of construction innovation.

Bodies, Affect and innovation

'Affect' has been defined in philosophy since Baruch Spinoza's 18th century concept of affectus, and later William James and Gilles Deleuze and Felix Guattari writings on affect as 'an ability to affect and be affected' - 'an augmentation or diminution in that body's capacity to act' (Massumi, 1987: xvi), where a body can be anything (Anderson, 2014). Thus affect has a long history of being used to describe a relational, or transpersonal, and future oriented, concept of agency that has much in common with that described by ANT scholars. Indeed, Latour (2004) himself views affect as an vital ingredient of not just agency but life: 'to have a body is to learn to be affected, meaning ‘effectuated’, moved, put into motion by other entities, humans or non-humans. If you are not engaged in this learning you become insensitive, dumb, you drop dead' (p205). Positive affects can thus be understood as brining about a heightened sensitivity to other bodies which results in a heightened capacity to act over them, while negative affects engender the opposite. While affects have sometimes been associated with the disruption, or radical contingency, of life (Massumi, 2002), affects are also vital to the managed stability of society. Consider contemporary workplaces, where affective labour - such as care, entertainment, motivation and inspiration - is a significance source of economic value and has become the target of management interventions (Hochschild, 1983; Hardt and Negri, 2000). Affects have 'become part of the institutions, practices and other things that make up society … settling limits or exerting pressure on what is thinkable and doable' (Anderson, 2014: 17).

The organizational significance of affect remains rather nebulous until we consider an example, such as that at the head of this paper. The site manager we observed was not simply controlling the site like a Foucauldian prison guard or Weberian bureaucrat, his agency, and that of his firm, partly stems from him being affected, positively or negatively, by the bodies he encounters: the bubbles in the Air Tape™, the litter on the floor, the unclean door, the worker he spotted from afar, and so on. These bodies affected this site manager and influenced his action over them, but so also did past bodily encounters, including other affects, he brought to these encounters (other

projects, other sites, other bodily interactions with materials, other NHBC 'Pride in Job' awards), as well as the emotional significations he and others gave to these encounters. Sometimes the encounter with a new body on the site would be positive, engendering new future capacities for him to act and think, sometimes they might be negative; either way, to conceptualize these lively encounters is to think with theories of affect (Anderson, 2014; Massumi, 2002).

Affects, and their influence on our future potentials to think and do are partly mediated by: the surprises of a bodily encounter; previous encounters our bodies have experienced; and the signifying systems, such as named emotions, available to register such affects (Anderson, 2014; Massumi, 2002). But affects have been said to extend beyond such proximate encounters too, as they become the target of apparatuses of power (e.g. texts on management motivation), open out into diffusive structures of feeling (e.g. 'age of fear') and atmospheres (e.g. the boredom of a meeting) between wider collectives of bodies (Anderson, 2014). As such, affects are neither objective nor subjective, autonomous nor deliberative, individual nor collective. This holistic approach to affect enables a greater recognition of the various ways affective life can be understood - taking us beyond the simple positive/negative affect binary drawn from Spinoza, and psychological notions of affects as biological, autonomic intensities. Building upon this inevitably brief account, in the remainder of this paper we explore in more detail, via an analysis of the already discussed zero-carbon home development, how an affective life might participate in construction innovation.

The Affective life of construction Innovation: The Zero-Carbon Home (ZCH)

METHODOLOGY

Targeted ethnographic fieldwork (Pink and Morgan 2013) was conducted on a large development involving a substantial number of innovations for sustainable construction. We visited the site twice as it neared completion, which produced 2 memos, 94 pictures and 6 semi-structured interviews – 5 of which were recorded and transcribed. In particular, we spent two hours on a site visit following the site manager and were able to observe his interactions with other workers, as well as following some of the technologies, which had been trialled as part of attempts to reach a zero carbon standard. We compared these observations with those made on a previous site visit to a different construction site. The data was thematically analysed.

The ZCH agenda was long mediated by affect, especially hope in a more sustainable, secure and equitable, future - an openness to a potential that our bodies can affect and be affected radically differently in the future than the present (Anderson, 2014). The hope for the ZCH was defined against other affects including: the fear of climate change, energy security, and fuel poverty; as well as a confidence that it was realistic, practical and flexible solution for the industry (NHBC, 2009). In this sense, ZCH was an apparatus through which affect became an object of power. However on the site we visited, this hope and confidence appeared misplaced:

> … the complexities of getting a sustainable water source up there, rainwater harvesting was horrendously expensive. Everything, the discussions and the amount of time and effort, consultancy fees that [we] have paid into just a wall, is horrendous (Project manager).

This project managers' lack of hope and confidence can be better understood as annoyance. Annoyance can be defined as an open-ended displacement of our future

capacities to affect and be affected by another body, or collective of bodies. For this project manager, these displacements were bodily manifest - he was being called to attend to the alignment of objects and people in a way that he felt was diminishing his, and his firm's ability to act, to their previously sought desire. As he then explained:

> The apartment block originally, when we first planned it, we had, down the one side of it was a green wall. So that again would have had complete planting down the side of it and, but then the complexities of getting a sustainable water source up there, rainwater harvesting, as you can imagine, to pump up seven floors, was horrendously expensive. Self-irrigating, everything, the discussions and the amount of time and effort, consultancy fees that [our firm] have paid into just a wall.

Annoyance was here interacting with yet more affects, in particular with a specific form of desire:

> if Government and local authorities want to steer developers that way, I think they, I think the incentives need to be greater. I don't think they're going to get anywhere by digging their heels in, forcing us through legislation to do it. I think they need to put their money where their mouth is and then we'll, the developers will be happy to work in partnership with them (project manager).

We might codify the project managers' desire as 'greed' - an affect that is strongly correlated with corporate capitalism (Anderson, 2014). Here greed can be understood as a structure of feeling, crystallized in specific instances, that presses and places limits on bodily capacities to affect and be affected (Anderson, 2014: 124). More specifically, greed pre-orientates people, things and ideas towards insatiable desires to accumulate other bodies, whether money, units of time, data, energy etc. Greed is clearly an essential part of construction management, where wealth, time and knowledge are valuable resources to be pursued. After all, bodies on site are compelled to be busy not idle or wasteful, just as material waste is to be minimized and plant equipment kept busy. As this project manager elaborated: 'ultimately you've got to remember, we're here to make a profit. And these elements of build or anything deviating from our standard house type or our standard build costs us more money'. Greed breeds annoyance at the ZCH in a manner that shifts the proclaimed hope for it to address fears of climate change etc., into hope that future innovations will be less profligate.

The crucial issue now is the role annoyance and greed played in the implementation of innovation. It might be suspected that annoyance and greed were actively undermining the implementation of ZCH. However, as per the example at the head of this paper we felt a high degree of care, even love, for the construction of innovations that constituted the ZCH. For example, the assistant site manager described in detail how he gradually learned to seal the air holes around the electrical sockets:

> What you'd do is generally, the rule of thumb, a light switch goes up, and sockets run down. So that should be sealed, again, when you do, put your full dab on an external wall, your full dab of plaster should seal that, stop any airflow like that. And what we do on the, on here, on a, when we put the trunking on, on top of the cables, we would then air tape say 150 mil down again, and then that would seal onto that as well, just to stop any.

This level of attention mirrors that of the site manager in our opening vignette. The assistant site manager was not simply following a bureaucratic plan to implement this innovation, he was not subject to surveillance from afar, he was intervening in the uncertain process of innovation - he was not expecting the innovation to do the work itself (technological determinism) but neither was he simply following out management instructions (social determinism). He was allowing his body to affect

and be affected, as he experimented with the technology to try and understand what it, and his body could do together. The assistant manager even described how he felt the air with his hand to discover the holes where cold air could breach the insulating material. In other words, the bodily capacities of this assistant site manager, the sensitivity of his body to the aims and requirements of this technology, were mediated through an open-ended desire to interact with and be affected by another body to transform both (cf. Deleuze, 1994: 324) - resembling the 'love' for innovation described in Latour (1996) and de Laet and Mol (2000).Without this love for the technology it is difficult to imagine how the units being constructed would have archived the required level of performance; in ANT parlance, how could the ZCH ever be 'black boxed'.

Another equally potent positive affect experienced on our case site was pride. Pride was perhaps the most visibly codified emotion on the site we visited, not least because of the wall of NHBC 'Pride in the Job' awards we were initially shown by the site manager. In affective terms, pride can be defined as an intense attachment to a certain body's unknown capacities to affect which augments, rather than displaces (as in love), our sense of ourselves as distinct from others. To coin a slogan: we may lose ourselves in love (Deleuze, 1994: 324), while we are proud of ourselves for having loved and thus possessing the potential to love (Aristotle, book IV). But just as with love, pride requires that we must suspend the limitations of what we think our body or that of another can do (Massumi, 1987). If we assume our body cannot affect or be affected we cannot be proud of it or other bodies. On our case site, pride, as with other affects (e.g. trust), was one outcome of affective encounters to care and love technologies. But unlike love or care, pride is integral to a process of subjectification, wherein an actor's intense love or care for another body (human or nonhuman) is rendered central to enduring ways in which certain bodies, actions and encounters, are valued and viewed as distinctive. The project manager described the site manager thus:

> the site manager that's currently on [the site] is a chap called [Bob] and he was involved in [another experimental project]. He does seem to land himself on the more complex renewable solution schemes … He's an NHBC award winning site manager. So he really does go that extra mile when he delivers his, he's got a, he's a very proud man. That's a good way to describe him.

While the criteria, or in ANT terms calculative device, employed to evaluate NHBC Pride in Job awards are largely related to the achievement of certain technical standards and management competencies (NHBC, 2016), the prominence of 'pride' reinforces the idea that these skills are mediated through the affective life of a building site. What is more, these awards also encompass two distinctly transpersonal affects: (i) 'Leadership - reflected by a high level of morale and motivation on site' and (ii) The 'X factor' - that certain something that sets the site manager apart from his peers' (NHBC, 2016). Management success, including the successful implementation of innovations, is here being rendered actionable by an apparatus of power that targets affects. And moreover this specific affect - pride - is said to be material and socially mediated: it is not to be measured by purely subjective (a feeling about the morale or X-factor on site) or objective means (adherence to a design plan, control of a budget, or the quality of brickwork) but both. The NHBC awards, as an apparatus of power, are suggestive that pride, just as annoyance, love, fear and hope, is transpersonal, objective and subjective, shaping (though not determining) future potentials for how bodies (people, ideas, things) can be affected and affect others, not least ZCH innovations. As one previous award winner explains:

> Sometime in everyone's life you get that split second, that rush, and winning a Pride in the Job Award gave me that exact feeling. Winning a Supreme Award gets harder every year as all the other site managers up their game. You've got to keep ahead of the field. The competition is fierce but the rewards are great. I'm always anxious when the judges arrive on site because they turn up unannounced, but in fact I'm happy for them to see my site at any time. It's always run as if a Pride in the Job judge was about to arrive (NHBC, 2016).

CONCLUDING COMMENTS

The purpose of our paper was to consider how affect theory might help us understand construction innovations, especially how they travel and become 'black boxed', when the actors involved are difficult to know and control in advance (Green, 2006; Thiel, 2013). We addressed how theories of affect, and specific affects (annoyance, hope, fear, pride, love), which are always socio-material mediated, set potentials for future action that influence processes of innovation enrolment. Our analysis, while suggestive rather than comprehensive, indicates that the affective life of building sites is rich and intimately connected to construction innovations. While affects are sometimes the objects of apparatus of power (such as the hope/fear around ZCH cultivated by institutions such as the Zero-Carbon Hub, or the 'Pride in the Job Awards' from the NHBC), these affects interact in complex ways with other modalities of affect, such as encounters from which emerges love or annoyance, or the wider structured feeling of greed that infuses corporate capitalism. In our case while the site managers we encountered may feel individually proud of their work, and be awarded as such, it is notable that the project manager was at least partly annoyed by the profligacy of their efforts. More widely, the affects that appeared capable of driving the implementation of the innovation on the development site (love, pride) appeared detached from those targeted by ZCH policy (hope, fear) and so incapable of challenge the affects that mediated the critique of the ZCH (annoyance, greed). We can only speculate how the story of the ZCH may have unfolded differently if the professional pride for loving your work and that of others, was attached to the hope for a more sustainable, secure and equitable, world rather than corporatist greed. Given the potential of these affects to influence how innovations are implemented, we hope that other researchers are stimulated by our arguments and analysis to elaborate in more detail on the variety and significance of the affective life of building work and its influence on significant matters of concern such as the implementation of innovations.

REFERENCES

Amabile, T M, Barsade, S G, Mueller, J S and Staw, B M (2005) Affect and creativity at work. *Administrative Science Quarterly*, **50**(3), 367-403.

Anderson, B (2010) Modulating the Excess of Affect: Morale in a State of 'Total War'. *In*: M Gregg and G Seigworth (Eds.) *The Affect Theory Reader*. Durham, NC: Duke University Press, 161-185.

Anderson, B (2014) *Encountering Affect: Capacities, Apparatuses, Conditions*. Farnham: Ashgate.

Baron, R A, and Tang, J (2011) The role of entrepreneurs in firm-level innovation: Joint effects of positive affect, creativity, and environmental dynamism. *Journal of Business Venturing*, **26**(1), 49-60.

Callon, M (1984) Some elements of a sociology of translation: Domestication of the scallops and the fishermen of St Brieuc Bay. *The Sociological Review*, **32**(S1), 196-233.

Choi, J N, Sung, S Y, Lee, K, and Cho, D S (2011) Balancing cognition and emotion: Innovation implementation as a function of cognitive appraisal and emotional reactions toward innovation. *Journal of Organizational Behavior*, **32**(1), 107-124.

Dainty, A R, Bryman, A, Price, A D, Greasley, K, Soetanto, R and King, N (2005) Project affinity: The role of emotional attachment in construction projects. *Construction Management and Economics*, **23**(3), 241-244.

De Laet, M and Mol, A (2000) The Zimbabwe bush pump mechanics of a fluid technology. *Social Studies of Science*, **30**(2), 225-263.

Deleuze, G (1994) *Difference and Repetition*. London: Continuum.

Drejer, I and Vinding, A L (2006) Organisation, 'anchoring' of knowledge, and innovative activity in construction. *Construction Management and Economics*, **24**(9), 921-931.

Dubois, A, Gadde, L.-E (2002) The construction industry as a loosely coupled system: Implications for productivity and innovation. *Construction Management and Economics*, **20**(7), 621-631.

Dulaimi, M F, Ling, F Y Y and Bajracharya, A (2003) Organizational motivation and inter-organizational interaction in construction innovation in Singapore. *Construction Management and Economics*, **21**(3), 307-318.

Gajendran, T, Brewer, G, Gudergan, S and Sankaran, S (2014) Deconstructing dynamic capabilities: The role of cognitive and organizational routines in the innovation process. *Construction Management and Economics*, **32**(3), 246-261.

Gambatese, J A and Hallowell, M (2011) Enabling and measuring innovation in the construction industry. *Construction Management and Economics*, **29**(6), 553-567.

Green, S D (2006) The management of projects in the construction industry: Context, discourse and self-identity. *In*: D Hodgson and S Cicmil (Eds.) *Making Projects Critical*. Palgrave, 232-251.

Hardt, M and Negri, A (2001) *Empire*. Cambridge, Mass: Harvard University Press.

Hartmann, A (2006) The context of innovation management in construction firms. *Construction Management and Economics*, **24**(6), 567-578.

Haynes, N S and Love, P E D (2004) Psychological adjustment and coping among construction project managers. *Construction Management and Economics*, **22**(2), 129-140.

Harty, C (2008) Implementing innovation in construction: Contexts, relative boundedness and actor-network theory. *Construction Management and Economics*, **26**(10), 1029-1041.

Hochschild, A (1983/2012) *The Managed Heart: Commercialization of Feeling*. Berkeley, CA: University of California Press.

Latour, B (1987) *Science in Action: How to Follow Scientists and Engineers through Society*. Cambridge, MA: Harvard University Press.

Latour, B (1996) *Aramis, or The Love Of Technology*. Cambridge, MA: Harvard University Press.

Latour, B (2004) How to talk about the body? The normative dimension of science studies. *Body and Society*, **10**(2-3), 205-229.

Linderoth, H C (2010) Understanding adoption and use of BIM as the creation of actor networks. *Automation in Construction*, **19**(1), 66-72.

Massumi, B (1987) Notes on the translation and acknowledgments. *In*: G Deleuze and F Guattari (Eds.) *A Thousand Plateaus: Capitalism and Schizophrenia*. London: Continuum, xvi-xix.

Massumi, B (2002) *Parables for the virtual: Movement, Affect, Sensation*. Durham, NC: Duke University Press.

NHBC Foundation (2009*) Zero Carbon Homes - An Introductory Guide for Housebuilders, NHBC Foundation*. Available from http://www.nhbcfoundation.org/Publications/Guide/Zero-carbon-homes-an-introductory-guide-for-housebuilders-NF14 [Accessed 20th June 2016]

NHBC (2016) *What the judges are looking for: what it takes to be an NHBC Pride in the Job winner*. NHBC. Available from http://www.nhbc.co.uk/NewsandComment/PrideintheJob/Judgingprocess/Whatthejudgesarelookingfor/ [Accessed 30th June 2016]

Pink, S and Morgan, J (2013) Short-term ethnography: Intense routes to knowing. *Symbolic Interaction*, **36**(3), 351-361.

Shepherd, D A and Kuratko, D F (2009) The death of an innovative project: How grief recovery enhances learning. *Business Horizons*. **52**(5), 451-458.

Thiel, D (2013) *Builders: Class, Gender and Ethnicity in the Construction Industry*. London: Routledge.

INFORMATION, KNOWLEDGE AND LEARNING

ON THE DOING OF BUILDING WORK: 'WAYS OF KNOWING' AS MODES OF COPING WITH COMPLEXITY

Finn Orstavik[1] and Andrew Dainty[2]

[1] *Department of History, Sociology and Innovation, University College of Southeast Norway, PO Box 4, Borre, NO-3199, Vestfold, Norway.*

[2] *Civil and Building Engineering, Loughborough University, Ashby Road, Loughborough, Leicestershire, LE11 3TU, UK.*

Research employing a practice lens has demonstrated that emergent, informal and tacit ways of knowing are influential in the production of the built environment. In some respects, practice theory helps reveal something of the underlying complexity of building work. Indeed, large, real world systems are unavoidably complex and this complexity can only be restructured; it cannot done away with. Workers have to cope by way of both established routines and emergent practices. However, the relationship between practice and complexity is seldom studied within the construction management literature, and so that "ways of knowing" might represent approaches to coping with complexity has so far not been made explicit. In this paper we argue that combining systems and practice theoretical concepts might provide new insights into the intricacies of construction production. We draw upon ethnographic vignettes to illustrate how it is possible to analyse how complexity is processed in practice and how unpredictability and uncertainty in several disparate systems are routinely dealt with through building work. This 'knowing-in-practice' manifests as a mode of coping with complexity and as emergent outcomes of creative efforts drawing on a combination of established routines and informal practices. Further explicating how this happens represents a significant research agenda, one which could begin to close the gap between the dominant focus on codifying construction management practices on the one side, and bettering our understanding the actualities of building work on the other.

Keywords: complexity, emergence, ethnography, practice theory, systems theory.

INTRODUCTION

Despite arguably being one of the most prevalent topics within the project management literature in recent years, the focus of analysis around complexity is mainly on how to organise for complexity, rather than on the ways in which complexity is dealt with in the process of doing building work. Reflecting Cooke-Davies et al (2007) in relation to the complex responsive processes of relating, this refocuses attention from management 'of' project complexity to managing 'in' complexity. However, the mobilisation of concepts taken from complexity theory remains limited. Brady and Davies (2014, p. 22) cite Geraldi, Maylor and Williams' (2011) claim that 'complexity remains ambiguous and ill-defined in much of the project management literature'. They review some of the important contributions to this literature and propose a simple synthesis in the form of a distinction between structural and dynamic complexity. These are defined respectively as 'arrangement of components and subsystems into an overall system architecture', and as

[1] finn.orstavik@hbv.no

Orstavik, F and Dainty, A (2016) On The Doing of Building Work: 'Ways of Knowing' As Modes of Coping with Complexity. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 669-678.

'changing relationships among components within a system and between the system and its environment over time' (Brady and Davies, 2014, p. 24). Managing both of these aspects is essential for project performance, but in doing so a balance has to be struck between hierarchical structuring and control (to curtail structural complexity), and the need for involvement, interaction and innovativeness (in finding ad-hoc solutions to emergent problems). It would seem, therefore, that the complexities of project work will always require a blend of control and emergent practice, and that formality/informality will inevitably be mutually constituted in, and through, action.

As has been argued cogently by Kreiner and Damkjær (2011), appearances are often deceiving in construction, and it is very easy to draw hasty conclusions (or learn the wrong things), from successes as well as from failures in construction work. This is because, in the practice of building many things are related, and in ways that are often surprisingly hard to grasp and even more difficult to predict. One reason for this is that actions that at first sight are considered relevant with respect to only one system often are revealed as having effects in several systems at the same time. Specific examples of this will be given as illustrations in two vignettes below, to make it easier to appreciate that many of the intricacies encountered in the production of the built environment arise "behind the scenes" or in what can be seen as layers of project realities located below the observable surface of operations. The "art of building practice" encompass making sense of these embodied and tacit aspects of construction. Coping with complexity by managing it (curtailing it, structuring it) and at the same time navigating in it represents a core challenge for the construction practice. Exploring this aspect of construction and building in turn represents an important challenge for construction research, and in this context Pink *et al.*'s (2010) argument that theories of practice, knowing and aesthetics promises more theoretically sophisticated ways of understanding building work is particularly significant.

The question addressed in this paper is whether it makes sense to develop a theoretical perspective on construction that combines insights from systems theory and practice theory when the goal is to understand in new and incisive ways what goes on in the production of the built environment. This is not to say that such perspectives are commensurable, but we do posit that their co-mobilisation might provide new ways of thinking about the doing of building work. Thus, whilst the positioning of this research observes calls for a renewed focus on the importance of informal and emergent practices in construction practice (i.e. Chan and Räisänen, 2009), our focus is on complexity as a systemic phenomenon. Couched in this way, 'knowing' in construction work can be conceived of as emergent, creative accomplishments in which complexity is navigated, but also as modes of managing - or curtailing - complexity, by way both of established routines and informal practices. "Ways of knowing" are then the established conceptions and procedures (routines) representing the practice of diverse contributors and stakeholders in construction, and the argument made here is that these various approaches embedded in practice represent different modes of coping with complexity. Further explicating how this happens, and how different approaches add to or interfere with each other, provides a significant research agenda for those seeking to begin to close the gaps between construction procedures and the (often conflicting) actualities of construction practice.

THEORIZING THE LINK BETWEEN EMERGENCE AND COMPLEXITY OF BUILDING

Complexity, which is a trait of systems, has emerged silently to become an essential feature of modern society and a major challenge in the public sector as much as in private enterprise (Rycroft and Kash, 1999). The basic reason is that the world due to constructive efforts of human beings is becoming increasingly systemic. Complex systems are 'made up of a large number of parts that interact in a non-simple way', according to Simon (1962). Luhmann, drawing on systems theoretical concepts from Simon and others, explains complexity in his own meticulous way (Luhmann, 1984, 1995). Systems, he says, are sets of connected elements in space and time. Since elements have limited ability to relate to other elements, and since the number of possible linkages in a system increases geometrically - that is, much more than the number of elements - elements cannot all be *directly linked* in large systems. It is this lack of integration, Luhmann says, that makes systems into complex systems; that makes the interaction of parts *non-simple;* and that makes uncertainty into an inexorable part of complex systems' behaviour.

In the domain of construction research, Baccarini (1996) in his survey of contributions that analyse complexity in construction concludes that complexity in construction relates to (1) the differentiation and number of elements (e.g. tasks, specialists, components) and (2) connectivity and the degree of interrelatedness and interdependence between these elements. He argues that construction complexity takes many forms, and that it is important to be specific about the type of complexity that is being considered. Whether this complexity is a product of the increasing interrelatedness between elements or the incomplete integration and the specific configurations of linkages is debatable, but according to Williams, what is clear is that the heterogeneity of technical systems and their multiple dependencies contribute greatly to complexity in projects (Williams, 1999). Not all of these depend on each other, but many do, and in ways that are not always explicit and easy to map (Baccarini, 1996; Gidado, 1996).

It has been claimed that construction is among the most complex and fragmented (least integrated) of industries (Fearne and Fowler 2006). A large number of professions and trades representing heterogeneous knowledge bases contribute to construction processes. Williams (1999) argues that technological and organisational complexity is exacerbated by project goals that are ambiguous and changing during the course of projects. Indeed, the social arrangements and processes of relating that are involved in any construction process are important factors that affect project performance (Bresnen *et al.* 2005a, 2005b, 2005c). As Gidado points out, growth of ever-larger production systems with increasingly heterogeneous constituent elements makes construction complex:

> The continuous demands for speed in construction, cost and quality controls, safety in the work place and avoidance of disputes, economic liberalization and globalization, environmental issues and fragmentation of construction have resulted in a spiral and rapid increase in the complexity of construction processes (Gidado, 1996, p. 214).

Similarly, Cicmil and Marshall (2005) draw attention to ambiguity and unpredictability created by multiple and conflicting interests, power asymmetries and unstable and implicit objectives as other factors contributing to pervasive complexity in construction. Based on an ontology of becoming they view projects as processes of complex and unfolding social arrangements.

To sum up, complexity in the form of incomplete, unstable but patterned integration of large and heterogeneous sets of elements is prevalent in construction and has been dealt

with in a broad range of contributions to the literature on projects and their management. Complexity makes unpredictability, uncertainty and risk into basic attributes of the realities of construction across the individual, organizational and industry levels. The process view and theoretical perspectives that highlight the importance of emergent phenomena represents a departure from more instrumental and rational theory and provide a useful point of departure for considering how people who work in such a complex arena cope with complexity. At the same time, reasoning regarding complexity challenges based on systems theoretical concepts open up an opportunity for new and more nuanced ways of articulating how practice is geared to overcome the effects of complexity, and how diversity in approaches has effects on production in projects.

COPING WITH SYSTEM COMPLEXITY: A SECONDARY ANALYSIS

To start unpacking how construction practices are geared towards dealing with complexity, an obvious option is to categorize complexity based on the kind of systems which are involved and within which complexity arises. Examples of types of complexity that can be identified in construction in this way include:

- Complexity of mechanical and technical systems making up a built object, including a very large range of basic fabricated elements, such as beams, prefabricated concrete elements, fixtures, tubes, etc., and including advanced technical systems such as elevators, heating systems, electrical distribution systems, etc.
- Complexity of machinery and technology used during the design and building phases, such as the computers and software of BIM systems, lifts, transport equipment, etc.
- Complexity of economic, contractual and administrative systems which are part of a construction project.
- Complexity of social relations between human beings within and between organizations involved in the project.

A somewhat more crude way of distinguishing between different complexities in construction is in relation to two different domains within which they are rooted, namely the technical and social systems. Merely seeing complexity as an attribute of social and technical systems makes it possible to understand better how actors deal with complexity.

In this paper we illustrate this by way of a secondary analysis of high quality published research on the realities of construction work. These interesting contributions formed part the special issue edited by Chan and Räisänen (2009) on informality and emergence. Research carried out on-site by Baarts (2009) and Styhre (2009) both offer ethnographic insights into realities in two complex construction projects. They contain rich field notes that render it possible to reinterpret their data employing a systems perspective. We fully acknowledge that our re-analyses will not capture the detail, insight or nuance of the original authors, nor will our repurposing of their work add value to the original aims of their work. We further acknowledge that we have drawn conclusions here based on an incomplete knowledge of the field site and the data itself. However, we draw upon these excellent studies merely to illustrate the potential intersection of complex thinking with practice-based accounts.

Vignette 1: Coping with complexity in safety work (Baarts 2009)

The paper by Baarts (2009) reports on a fascinating study of safety work, in which she uses ethnographic methods to understand more fully what safety means for the workers,

and how safety is dealt with at the building site. The editors characterize her contribution in the following way:

> Baarts' paper describes a fascinating ethnographic exploration of the actual practice of safety on a construction site. Through a selection from her copious field notes, she offers us glimpses of how actors on a construction site navigate between collective and individualistic preferences in dyadic and triadic relationships. Using ethnography, Baarts is able to show how seemingly immutable safety laws and regulations become elastic and adjustable to particular local circumstances, and then, she argues, become established norms that determine the nature and scope of permissible action on site. (Chan and Räisänen, 2009, p. 910.).

We have drawn upon notes on one specific incident recorded by Baarts, in which she and a co-worker, Sebastian, were involved in a near accident as two cranes collided and parts of one of the cranes fell down. The dynamic of the situation is related to the fact that Sebastian is also the workers' safety representative on the site. Baarts' notes are presented on the left side in Table 1, along with our secondary interpretation of their significance regarding our own discussion of systems and complexity.

This incident reveals how workers disregarding rules often do what they do not for stupid reasons, but because situations are multifaceted - in the sense that actions they do in a specific situation actually affects *several systems at the same time*. In this case, we make the point that Sebastian as a co-worker and as a safety representative had to consider his action with respect to three different systems: the technical production system (the crane), the safety system (his role as safety representative) and the social system (his inclusion in the gang of workers).

Baarts argues that Sebastian disregards the safety system because of an inherent technical imperfection in this system, namely the lack of a sufficiently large safety line. An alternative interpretation might be that when attention is directed towards the ongoing complexity processing that this presents challenges in making integrating efforts in several systems at the same time. As a safety representative, Sebastian was responsible for taking action when onsite safety could be improved (the lamp on a jib arm had broken loose), taking care of the production system and re-enacting the safety system by playing his role according to the rules. This might suggest that *not using the safety line* was a deliberate integrative act *with respect to the social system of the gang*. Although it is impossible to know for sure from a secondary analysis, it seems improbable that this tacit knowing in practice would form part of any explicit rule-based system. Rather, it could be motivated by a "way of knowing" that copes with complexity in a tacit way, incorporating concerns that are not immediately obvious to observers, but representing systems integration across both technical and social systems.

Vignette 2: Coping with complexity in rock construction work (Styhre 2009)

As we have argued above, workers actively process complexity by integrative action. That is, they straddle many systems at the same time in the daily activities on a building site, and this complexity processing is an integral part of the 'ways of knowing' that is developed in and through the doing of construction work.

Table 1. The complexity of safety work

Field notes (Baarts, 2009, p. 953)	*Our secondary interpretation*
The two cranes in this particular area of the construction site had collided in mid-air. The jib arm of one crane had broken a lamp on the other's jib arm. (…)	The production system had malfunctioned; two cranes supposed to operate independently had collided. The consequence of the collision was that one subsystem, a crane, had been 'disintegrated' when a lamp broke of and fell down
Since the lamp on the one jib arm had broken loose, it had to be mounted back on the jib arm.	It is the task of workers to reverse the disintegration of the crane as a technical system. An integrative effort has to be made by re-mounting the lamp
As the safety representative, Sebastian was responsible for this task. He stepped into a carrier that had been tied to the crane.	There is a safety system on-site, which is both social and technical. There are materials in specific places, such as safety lines. Furthermore, tasks and roles have been specified and are allocated to people. In this situation, Sebastian is the safety representative, and acts accordingly by re-mounting the lamp on the crane.
He was not wearing a safety line. From the comments of the other workers, I understood that this was a violation of safety regulations. (…)	Sebastian does two things at the same time: he acts as a functional element of the safety system remounting the lamp, however, at the same time he chooses not to act as such an element when he disregards wearing the safety line.
Sebastian was then carried up to the jib arm where he mounted the broken lamp and was safely transported back down to the ground. (…)	The functionality of the technical production system is re-established, and earlier complexity structure is recreated.
Sebastian is a big man, too big to be able to fit into the safety belt required by safety legislation in this situation.	The safety system is in itself complex. There is a lack of integration, according to Baarts due to the fact that people who are too big cannot be accommodated as elements in the functional system.
	A different interpretation from Baarts' is that Sebastian had his own reasons for disregarding the safety rule of using a line. By disregarding this rule, Sebastian reinforces his own integration in the gang as a collective of workers.

The second paper we draw on here illustrates this point. Chan and Räisänen summarise this contribution to their special issue thus:

> Styhre theorizes on the nature of the term [tacit knowledge] as it applies to rock construction and concludes that it is wanting since the assumptions underpinning the literature on tacit knowledge are logocentric, i.e. grounded on the notion that language precedes and is constitutive of knowledge. Styhre argues that skills and operative vocabularies are only partially interdependent. There is another aspect of skills that is separated from language; rather it is dependent on the interplay between material practices and a person's sensory system, e.g. emotions and aesthetic senses (Chan and Räisänen, 2009, pp 910-11).

In this case, we do not have the information to make it possible to consider the social relations between workers. However, we extract a few passages from Styhre's field notes and analysis that in our view, clearly shows how workers operating complex machinery have to deal with multiple technical systems, and how the processing of the complexity of these systems is a largely tacit, informal and emergent phenomenon. The different aspects of operating machinery in rock construction, as described by Styhre, are

summarised in Table 2, along with our own systems-informed interpretations of what they mean in terms of coping with complexity. The vignette relates to the operation of machinery used to apply (spray) concrete on the raw walls inside a newly quarried tunnel.

Table 2. The complexity of operating machinery in rock construction work

Field notes (Styhre, 2009, p. 999-1000)	*Our secondary interpretation*
In the case of spray concrete, robots were used to spray the concrete on to the tunnel walls. The robot is here a concept denoting a rather complex set of interrelated technologies (…)	The production system is itself a complex technical system-of-systems
Operating the machine is not that difficult but to do it good is damn hard. Then you need substantial experience (…) To see the whole picture, to see the finished product: Some of them [the workers] are capable of doing a part of the work really well but then they have completely failed to take into account everything else (…)	The production machinery is designed to act upon its environment. A man-machine interface is created for a human being to monitor and guide the systems-environment interplay. The monitoring and guiding presupposes an overall understanding of both the production system itself, the environment, and the way these interact. This understanding is to a large extent tacit
	Those mastering the job are able to understand both the functionality and to sense the limitations of the production machinery
	This can be mastered only with a certain talent, and with a lot of practical experience.
What the skilled co-workers demonstrated was a certain sense of wholeness or unity, that is, the ability to align technology, materials used, the actual conditions in the workspace, and individual performances into a functional process. For instance, spray concreting included the ability to inspect and evaluate the rock surface and conditions of rock (i.e. in terms of the porosity of the rock or the amount of water leakage), the ability to undertake the actual operation of running the spray concrete robot (…) and to carefully pay attention to the equipment *en route*. In addition, all these activities are to be undertaken and executed during reasonably time-compressed conditions.	The most competent workers manage to integrate many different and heterogeneous elements, and a complex pattern of interplay, into a systemic whole. They also are able to grasp this whole as a dynamic, complex system, and to act as guides for the machinery to achieve an uninterrupted process and high quality results.
Quite often you hear sounds (…) you may see the movement of the machine (…) You may see that it is not functioning properly on the concrete: it puffs and hisses and then there is something wrong (…) You can hear on the beat of the pump that it works as intended.	Sensory information is critically important to be able to guide the process, as the overall production system has not been developed to the stage where it is able to monitor and regulate itself. The complexity of this imperfect system is such, that not controlling continuously the interplay of systems and environment, unavoidably will lead to sub-optimal outcomes, most probably systems break-down

The many aspects of the process have to be controlled in a time-critical manner, and the ability of the worker to manipulate parameters based on multiple sense data (sight, sound, smell, sense of rhythm, etc.) is crucial. The analysis in this case therefore highlights only integrative efforts that are within the technical domain. The example serves, however, to support a claim that that workers in their practice actively process complexity by way of integrative action, and that they do so by dealing with complexity in many systems at the

same time. Furthermore, their emergent and tacit 'ways of knowing' are instrumental to coping with complexity in the doing of building work.

DISCUSSION AND CONCLUSION

As pointed out in theoretical section above, elements of systems theory and practice theory may together open up new questions around the inherent challenges in the production of the built environment. Indeed, systems integration has been a concern of practice theorists already in the past. Gherardi suggests that practice is 'knowing how to align humans and artefacts within a socio-technical ensemble and therefore knowing how to construct and maintain an action-net, which is interwoven and deployed so that every element has a place and a sense in the interaction' (Gherardi, 2009, p.117, cited in Gluch, 2009, p.961). Although choosing words such as *action-net* and *ensemble*, what Gherardi describes here can easily be conceived of as acts of systems building and integration. Saying that every element should have "a sense of place in the interaction" can be stated in systems language as systems are being built and people have to attend to the complexity as the system that is being built.

To build effectively and efficiently and to create an object of high quality in a process that is safe for workers involved, both system building and complexity structuring has to be considered. Clearly, not everything can be connected directly to everything else, but both direct and indirect dependencies have to be taken into account. This is even more demanding than when, as Gherardi (2009) describes, an action-net has to be 'interwoven and deployed so that every element has a place and a sense in the interaction'. Our re-interpretations of small pieces of the works of Baarts and Styhre suggest the combination of formalised knowledge and emergent tacit knowledge has to be combined in order to cope with complexity. Not everything can be learnt through practice. Over time, knowledge about elements and linkages have to be accumulated and compiled in structured knowledge areas. Professionals and artisans live from the active relating of structured and explicit knowledge, and the tacit - or to use Styhre's term - aesthetical knowledge developed in practice. The substantive challenge is to see coping with complexity and the doing of building work as a product of the *combination of the informal and tacit ways of knowing with the formal and codified*.

Kreiner and Damkjær (2011) have argued that appearances are deceiving in construction. High levels of quality and safety can only be achieved if hasty conclusions based on experience, are avoided. One way to do this in construction research is to engage with theories of practice, knowing and aesthetics, which promise new and more adequate ways of understanding building work (Pink et al 2010). Following Pink *et al.*, we contend that more ethnographic research is needed to unpack the layers of reality that building workers have to take into consideration in their daily activities. At the same time, we believe the deeper understanding of multiple co-existing and interdependent systems add to this, and that the combination of concepts from earlier disparate theoretical areas will offer opportunities to better frame our knowledge of building work as a complexity processing system.

New research that builds on the ideas presented above is underway and will probe more deeply into the realities of building work. This will help untangle how practices and ways of knowing (encompassing established ways of knowing and working, as well as creative solutions to emerging challenges) are often anchored to disparate conceptualizations of what relevant systems are. Framed in this way, complementary and contradictory approaches to complexity processing are inevitable, but merely reflect the multiplicity of approaches to doing of construction work.

REFERENCES

Baarts, C (2009) Collective individualism: the informal and emergent dynamics of practising safety in a high-risk work environment. *Construction Management and Economics,* **27**(10), 949-957.

Baccarini, D (1996) The concept of project complexity - a review. *International Journal of Project Management,* **14**(4), 201-204.

Brady, T and Davies, A (2014) Managing structural and dynamic complexity: A tale of two projects. *Project Management Journal,* **45**(4), 21-38.

Bresnen, M, Goussevskaia, A and Swan, J (2005a) Editorial: Managing projects as complex social settings. *Building Rearch and Information,* **33**(6), 487-493.

Bresnen, M, Goussevskaia, A and Swan, J (2005b) Implementing change in construction project organizations: exploring the interplay between stucture and agency. *Building Rearch and Information,* **33**(6), 547-560.

Bresnen, M, Goussevskaia, A and Swan, J (2005c) Organizational Routines, Situated Learning and Processes of Change in Project-Based Organizations. *Project Management Journal,* **36**(3), 27-41.

Chan, P W and Räisänen, C (2009) Editorial: informality and emergence in construction. *Construction Management and Economics,* **27**(10), 907-912.

Cicmil, S and Marshall, D (2005) Insights into collaboration at the project level: complexity, social interaction and procurement mechanisms. *Building Research and Information,* **33**(6), 523-535.

Cooke-Davies, T J, Cicmil, S J K, Crawford, L H and Richardson, K (2007) We're not in Kansas anymore, Toto: Mapping the strange landscape of complexity theory, and its relationship to project management. *Project management journal,* **38**(2), 50-61

Fearne, A and Fowler, N (2006) Efficiency versus effectiveness in construction supply chains: the dangers of "lean" thinking in isolation. *Supply Chain Management: An International Journal,* **11**(4), 283-287.

Geraldi, J, Maylor, H and Williams, T (2011) Now, let's make it really complex (complicated) A systemic review of the complexities of projects. *International Journal of Operations and Production Management,* **31**(9), 966-990.

Gherardi, S (2009) Introduction: the critical power of the 'practice lens'. *Management Learning,* **40**(2), 115-28.

Gidado, K I (1996) Project Complexity: The Focal Point of Construction Production Planning. *Construction Management and Economics,* **14**(3), 213-225.

Gluch, P (2009) Unfolding roles and identities of professionals in construction projects: exploring the informality of practices. *Construction Management and Economics* **27**(10): 959-968.

Kreiner, K and Damkjær, L (2011) *Fejl i byggeriet? Når erfaringen fører os på vildspor*. København: Nyt Teknisk Forlag.

Luhmann, N (1984) *Soziale systeme. Grundriss einer allgemeinen Theorie*. Frankfurt am Main: Suhrkamp Verlag.

Luhmann, N (1995) *Social systems*. Stanford, CA: Stanford University Press.

Rycroft, R W and Kash, D E (1999) *The Complexity Challenge. Technological Innovation for the 21st Century*. London and New York: Pinter.

Simon, H A (1962) The architecture of complexity. *Proceedings of the American Philosophical Society,* **106**(6), 467-482.

Styhre, A (2009) Tacit knowledge in rock construction work: A study and a critique of the use of the term. *Construction Management and Economics*, ***27***(10), 995-1003.

Williams, T (1999) The need for new paradigms for complex projects. *International Journal of Project Management*, **17**(5), 269- 273.

EXPLORING THE WORK PRACTICES OF SITE MANAGERS AS PROCESSES OF EMBODIMENT

Rikard Sandberg[1], Christine Räisänen[2], Martin Löwstedt[3] and Ani Raiden[4]

[1 2 & 3] *Division of Construction Management, The Department of Civil and Environmental Engineering, Chalmers University of Technology, SE- 412 96 Gothenburg, Sweden*

[4] *Nottingham Business School, Nottingham Trent University, Burton Street, Nottingham, NG1 4BU, UK*

In construction, site managerial work has often been depicted as 'muddling through', skilfully solving problems as these inevitably crop up and trying to be everywhere at the same time. This perspective seems to give precedence to structural conditions in the industry when explaining micro-level practice on construction sites. Recently, however, organisation scholars have highlighted a need to investigate managerial practices as these unfold in everyday work. This means we ought to take into account the actual work activities that influence expectations, meanings and values about what is desirable and necessarily relate to everyday work. The purpose of this paper is to further explore how practice enactment and outcomes are embedded in the lived, everyday work activities of real human beings working on site. The focus is on the work stories of two site managers, a man and a woman, in a large Swedish construction company. Drawing on their stories we take a critical stance towards the established view that certain structural and cultural conditions are strong and sufficient precursors to predict work practice outcomes. We propose instead that practices enacted on site can better be understood as various processes of embodiment.

Keywords: managerial work, "muddling through", site managers, embodiment

INTRODUCTION

In a recent study Styhre (2012) depicted the work of site managers in construction as 'muddling through'; they skilfully solve problems as these arise and they try to be everywhere at the same time. Building sites have often been described as chaotic and complex (Cicmil and Marshall 2005; Ness 2010) and the 'muddling through' is Styhre´s conceptualization of a certain set of practices that are *required* by the site managers in order to cope with all the unanticipated problems unfolding in the realms of these site specific circumstances (Styhre 2012:139). Styhre also relates these circumstances to the overall characteristics of the construction industry and furthermore suggests that "a pattern similar to that of construction industry site management may also be observed in other industries that use complex project organisation as the principal organisation form" (*ibid*. 131).

At the heart of this reasoning is the notion that the practices enacted by managers on site can be causally derived from the structural affordances and constraints embedded in the site milieu. This can furthermore be seen as reflecting a general trend in construction research of providing macro-level characteristics interpretative

[1] rikard.sandberg@chalmers.se

Sandberg, R, Räisänen, C, Löwstedt, M and Raiden, A (2016) Exploring the Work Practices of Site Managers as Processes of Embodiment. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference,* 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 679-688.

precedence when explaining how the managerial work practices at the micro-level are shaped and can be understood (e.g. Dubois and Gadde 2002; Mäki and Kerosuo 2015, Dossick and Neff, 2011). There are however studies that contrast these conceptions. Löwstedt (2015), for example, draws on experience from doing an ethnographic study on a building site to argue that the practices enacted on the site cannot only be explained by contextual circumstances, but are also deeply embedded in personal dispositions and traits influenced by prior preconceptions, background, gender, and competitive spirit, among others. This personal story then points at a much more complex unfolding of site practices and is implying the need for further exploration.

The purpose of this paper is to explore the work of site managers and how it is enacted in regard to structural, cultural and practical conditions in the construction industry. Drawing on practice-based perspectives inspired by Tengblad (2012) and Alvesson and Sveningsson (2003; 2012) we explore how practice enactment and outcomes are embedded in the lived, everyday work activities of individuals working on site. Here, we focus on the work stories of two managers, a man and a woman, and examine their accounts of their day-to-day managerial practices and how they cope with their work. Our findings show that some of the most well-established structural (e.g. "loose coupling") and cultural (e.g. masculinity and paternalism) conditions indeed provides an institutional frame for managerial work situations on site. However, the stories also reveal that outcomes of work practices are not derived from macro-conditions *per se*, but are enacted in and through individual 'sexed' bodies producing meaning to the macro-conditions. This leads us to question the validity of the examined macro-conditions as isolated precursors to predict behaviours on a micro-level in the industry. Our study shows that a deeper understanding of *embodiment* in construction is essential in order to understand how micro-practices are enacted, as well as how macro-practices are embraced, resisted and altered.

THEORETICAL FRAMING

Organisation scholars have highlighted a need to investigate managerial work in organisations so as to take into account the work activities that influence workers' expectations, meanings and values about what is desirable and necessarily related to everyday work (Sveningsson et al., 2012). For instance, Tengblad (2012) advocates a practice-based approach to the study of managerial work and leadership so as to include the complexity, heterogeneousness, uncertainty and unpredictability of organisational work places. Using this approach, Alvesson and Sveningsson (2003) have suggested the need to re-think the work of managers and take into account the 'mundane', i.e. small acts that managers carry out every day such as listening and chatting, and which are often trivialised. In the leadership literature, however, much of the research has concentrated on upper-level managers and leaders. Recently, management researchers have started to bridge this gap, and in construction management, studies of lower-middle managers mundane work situations have increased (e.g. Mäki and Kerosuo, 2015; Styhre, 2006; 2011; 2012, Sandberg et al., 2016).

Earlier research on site managerial work in construction

Much research on managerial work in construction, however, takes the macro-level as a starting point and emphasizes the significance of structural conditions in the industry in shaping managerial work practices on micro-level (e.g. Djebarni, 1996; Mustapha and Naoum, 1998, Styhre, 2012; Mäki and Kerosuo, 2015). Here, many build on Dubois and Gadde (2002) and argue that the industry is characterized by loose

informal couplings between actors in the permanent industry network and those of the temporary organisations. In the individual construction projects, however, the various loosely coupled actors involved have to ensure that production activities are tightly coupled according to planned schedules and processes. These conditions call for a decentralization of authority and decision-making to the individual projects. The hub that shoulders these responsibilities and ensures communication, coordination and orchestration of all the interfaces is the site manager, who then needs to be attuned to the different cultures, processes and tools of the different interacting professions in the project (Dossick and Neff, 2010; Styhre, 2012; Mäki and Kerosuo; 2015). In this sense the site manager is pulled between rigorous planning for operations to run smoothly and solving a stream of unforeseen problems continuously arising in the project (Styhre, 2012).

Apart from the influence of structural conditions in explaining the managerial work practice, it is also argued that a gendered belief system plays a significant role. Styhre (2011) argues that a masculine ideology, e.g. a system of masculine beliefs, norms, assumptions and worldview, is rooted in construction practices and behaviours. For instance, it is suggested that masculine virtues of autonomy and self-sufficiency and a proclivity towards rough and heavy physical work is inherent in the mindset of the industry (Applebaum, 1999; Löwstedt and Räisänen, 2014). According to Styhre (2012), these conditions together with conditions emanating from the loosely coupled structure in the industry give rise to the reactive 'muddling through' response mentioned in the introduction. Here, it is suggested that site managers perceive their work as a skilful art of improvisational decision-making and problem solving with the overarching goal to continue production no matter what the circumstances. In accordance with this behaviour, it is argued that site managers develop a paternal role characterized by omnipresence and a 'crisis management' approach. In turn, these behaviours can be linked to a view of overwork as virtue, or as Styhre summarizes it "trying to be everywhere at the same time" and shouldering responsibility for all the processes and outcomes in the project.

In this paper, we apply a critical lens on the assumption that structural (loose coupling) and cultural (masculinity/paternalism) conditions are strong and sufficient precursors to predict work practice outcomes of site managers in the construction industry. We do this by building on practice-based perspectives inspired by Tengblad (2012) and Alvesson and Sveningsson (2003; 2012) to explore how practice enactment and outcomes are embedded in the lived, everyday work activities of the individual managers working on site. This perspective acknowledges prior research emphasising that construction inherently is a "site specific project-based activity" (Cox and Thompson, 1997 cited in Dubois and Gadde, 2002). By taking this "site" perspective seriously, an approach that considers the recursive relationship between micro- and macro practices is applied in the paper.

METHOD

The data draws on in-depth life story interviews with two site managers in a large Swedish construction company. The interviews were part of a pilot study including data from 7 site managers and 1 production manager in Western Sweden. The purpose of the study was to investigate what it entails to be a middle manager in the construction industry. The selections of the two specific life stories were purposive since we wanted to contrast different approaches to, and experiences of, lived everyday managerial practices in construction. The managers, a male and a female,

were selected because they had different backgrounds in the industry and represented what we perceived as two contrasting work practices. The female manager had worked long in the industry and had many years' experience of working on site. She had no prior academic education. The male manager had only worked a few years in the industry. He started in a managerial position and had his experience in the line organisation.

The respondents were ensured anonymity in that all specificities enabling identification would be neutralised, and we offered them the possibility of reading transcripts if they so wished. The interviews were informal, taking the form of casual conversations lasting more than 60 minutes each. They were audio-recorded and transcribed verbatim. The location for the interview was at the respondent's office on location. A brief interview guide was used to keep interviewer intervention at minimum.

The respondents were asked to provide the essential bio-data concerning career trajectories. After these preliminaries, they were encouraged to talk freely about their work and work role. Our prompts were open-ended; we wanted them to tell us about their workdays, how they generally went about planning and managing site activities, what issues arose and how they dealt with them. 'Free' storytelling has been suggested as an appropriate interview technique for the purpose we had in mind where interviewees' personal stories are allowed to evolve, and in which their underlying assumptions and beliefs guide the conversation (Clandinin and Connelly, 2000). (Note: this study forms a part of a much larger, ongoing study in which the same methodological approach is used).

A narrative approach was used to analyse the transcripts of the interviews. Narratives have long been viewed as fundamental forms of human understanding and sense-making, through that individuals structure and organise their experiences of the world (Polkinhorne, 1995). Drawing on Polkinhorne (1995) and Lindebaum and Cassell (2012), narrative analysis was applied on the data in order to identify and code the various fragments that made up the narratives. These fragments were then sorted under themes that linked to the overall common plot concerning how the narrators experienced their work practices.

FINDINGS

Two core themes emerged as central to the project managers' narratives of their workdays: (i) how they experienced their day-to-day work activities and (ii) different approaches of enactment of micro-practices at work

Experience of their everyday work activities

Manager A

Manager A depicted his work as highly demanding with multiple expectations on his role, both by others and on himself. He spent much of his time on planning and administration and felt that he did not have sufficient time to go out and be a support on-site managers, a task that he felt was expected of him. In this sense, he described a situation where he was "stuck in the office" and pulled between administrative tasks and that of being a support and collaborative problem-solver on site. Furthermore, he was managing several projects at the same time. This strained situation in turn created

feelings of insufficiency, fragmentation and a need to be in several locations simultaneously.

> 1.I guess one of the main purposes of my role is to be out in the projects and be a support for production… But this is the thing I work least with. I simply do not have any time to go out in the projects... If they want my support, I tell them that they have to call me.

In addition, manager A experienced that he had limited abilities to influence his work tasks and work load. This is something he sees as a demotivating factor, and which at periods creates an unsustainable work situation. The cause for this, according to him, is a lack of sensitivity and responsiveness from the organisation.

> 2.When I asked for help I got the response: "you have to prioritise yourself what projects you see as most important". This is something I feel I cannot do, because then we will have site managers without jobs in a few months.

Manager B

In terms of workload, Manager B depicted a similar experience as manager A. She worked excessively long hours and felt a strong tension between expectations on project planning and managing budgets on one hand, and supporting site managers in their daily work on the other.

> 3.For a person wishing to be a present manager on site, this is a constant headache!

Manager B recounted a highly demanding work situation where she, during longish periods, practically worked "non-stop". She admitted this was exhausting, leaving her no time to devote to her family and private life. However, compared with manager A, her perceptions of autonomy and motivation at work were very different. She felt that she had a lot of freedom to influence her work in directions that she perceived meaningful and satisfying. This in turn increased her feelings of commitment toward her work, and was a strong source of meaning in her life.

> 4.As long as I can work with what I want in the way I want, I enjoy working here. Today I am definitely in such a position. There are tasks that I am not interested in and there is no way that I am going to perform these.

Her autonomy was manifested in that she refuted certain work tasks that she did not perceive as interesting, rewarding and/or important. Instead she oriented herself toward a role that she perceived better matched her competencies. This role could be described as flexible and flowing in that she adapted her work tasks and activities according to circumstances in different projects. This, however, was always executed according to her own interpretations and decisions, not from top-down decisions. In this sense, she experienced that her own authority and responsibility was loosely coupled from the main organisation.

Approaches to micro-enactment of work practices

In relation to how the two managers perceived their work, they also developed different work strategies and practices.

Manager A

Manager A developed a work practice that was characterised by reactiveness and ad-hoc solutions. A recurrent theme in his story was a lack of control over his work situation. He conveyed an image of structural limitations, and being stuck in a stream of activities that he had scant abilities and possibilities to influence. In a sense, his approach resonates with Styhre's concept of 'muddling through'. He coped with his work by taking on a reactive approach and "fighting fires" when they had already

arisen. For instance, he had established a practice of taking "shortcuts", i.e. to minimise paperwork in order to meet the many contrasting demands that he experienced were demanded of him. This experience ties back to the increased bureaucracy and administration imposed on site managers in the projects.

> 5.We have a business system and decision structures we are meant to follow but there is no time for that. I have to take many shortcuts in order to get my workweek anywhere near 40 hours a week… But if there was to be an internal audit I would have to fill in the papers afterward so I don't get my fingers smacked.

> 6.It is better that everyone has a job and that we deliver money rather than to fill in the right papers. Higher managers understand this.

Feeling locked into a structure where he could just about cope with the demands had a negative impact on him. He experienced high levels of stress and had been close to burnout on several occasions. He also recurrently thought about resigning.

> 7.The previous year was chaotic. Then I was on the verge of quitting my job … I couldn't cope. In principle I worked my 9 hours every day and then I also often worked [at home] from 8 pm until 12 pm many days a week … several weekends as well to get it to work. I was close to burnout then.

Overall, manager A sees increased support, personnel and resources as a key to improve his work situation. However, he is rather pessimistic regarding the prospects of this being fulfilled.

Manager B

In contrast, manager B had developed a work practice characterised by proactiveness and agency. Her story conveyed an image of being partly independent of structural limitations in the organisation and instead influencing her environment in different directions. Although she experienced this approach as highly demanding due to the time and energy it took to deploy a proactive management approach, she also saw the results of this as rewarding. This indicated that she was "on top of things" and could steer the projects, as well as her own work situation in directions that she perceived as efficient.

As manager B saw it, the common view of being a site manager is portrayed as having a highly demanding work role with a tremendous amount of responsibilities. However, she emphasised the significance of the role as a hub in the industry and that it provides power and the ability to wield influence.

> 8.As a site manager, you are personally responsible for the work environment and the personnel. New personnel taking our site-manager courses get really frightened when they see how many responsibilities they will have … but they don't see how much they can influence.

Manager B acknowledges that her seniority has contributed to her autonomy. Her managers have given her freer reins since she often delivers good results. Also, she says that "knowing the rules of the game is necessary in order to know what buttons to push in order to get things to happen". Here, she was convinced that her many years of working on site have contributed to her understanding of the industry and the culture.

> 9.When you have worked in the industry for such a long time as I have, you have learnt to play the game.

However, she does not see her experience and seniority as the major cause. When asked why she can shape her role so freely, she ascribed it to the fact that she is a woman.

> 10. I often feel that I have an advantage in being a woman … yes really! Because there are so few women in the industry men are scared to step on your toes. I have learnt to benefit from this in order to get my ideas through and form my role the way I want.

We don't think it is an overstatement to say that her statement is interesting, especially in light of a common view of women as de-preferred in leading position in construction. Manager A stated that personnel and managers in construction usually were not accustomed to "competent women with authority" in this position. Over the years, she has learnt how to use this aspect to strengthen her legitimacy and impose her decisions. This, she said, was the major reason why she could shape her role so freely.

DISCUSSION AND CONCLUSION

In several ways the data support the image of a construction manager as someone who is 'muddling through', especially perceived the concerning tension of managing relationships between actors in industrial networks (project management activities) and being involved in site-managerial activities. Furthermore, the reactive management approach deployed by manager A strongly resonates with the view of construction middle managers as ad-hoc problem solvers. Here, however, we want to emphasise the difference between loose coupling as a precondition for 'muddling through', and 'muddling through' as a *potential* coping response for how site managers *enact* their perceptions and interpretations of the preconditions.

This distinction indicates that practice outcomes are contingent of how individuals enact different realities on site. This process becomes evident in how manager B talks about her work. While 'muddling through' is depicted as a reactive coping strategy, her coping response rather consisted of actively shaping work activities and the work role. Manager B did not perceive herself as being caught in a stream of activities that she could only just cope with; rather, she saw herself as being on top of things and shaping her context. This perspective considers the role of human agency and that the myriad of practices developed on site also have the capacity to inform macro-practices. In this perspective, lived realities on the construction site become elevated from the shadows of structure and loose coupling to a central scene where practices are established in the industry. This leads us to question if it is fruitful to preferentially perceive managerial work practice in an industry as a result of structural conditions (the loose coupling) in that industry (i.e. an externally independent force that shapes micro-conditions) and consequently neglect how broader sets of conditions, such as culture, ideology, institutions and practises, arise and becomes reproduced in the messiness of 'mundane' day-to-day situations of people working on site. We suggest this position warrants further empirical research of work practices at the micro level.

The goal of this paper, however, was not only to establish a chicken-egg problematisation of the nature of the construction industry, but also to contribute with knowledge on how we can better understand varieties of practices, their enactments and outcomes in regard to conditions in the industry. What causes managers to develop different practices in their work? Here, it is important to explore relationships between potential dimensions that have the capacity to influence practices, for example at the interfaces between managerial levels. Thus, we in part agree with Styhre's (2011) discussion of masculine ideology and paternalism as a source of practice outcomes. In the case of the managers in our data, we could interpret paternalism as being a potential reason for managers A and B's developing separate

work practices. However, the background and experiences of the managers provide further clues. Manager A had only worked a few years in the industry, and started in a managerial position directly after his university studies. A had no experience of working with manual labour on site and can hardly be described as fostered in the 'paternalistic' tradition characterising roles and labour on construction sites. Manager B, however, has a long experience in the industry, and had worked both on site and in the line organisation. Many of B's accounts about work and management evoked what we interpreted as stereotypical images of paternalism, e.g. being autonomous and self-sufficient, upholding a virtue of overwork and carrying the burden of feeling responsible for all processes and results in the project (Applebaum, 1999; Styhre, 2011). In this sense, manager B's work orientation and behaviours can be understood as having been fostered in the masculine and paternal culture on site. However, based on these data, we also find indications that paternalism and 'muddling through' are not necessarily two sides of the same coin. For instance, although manager B has been fostered in a paternal context on site, she does not seem to have developed a reactive and ad-hoc oriented attitude and behaviour as suggested in the concept of 'muddling through'. This leads us to query whether paternalism could also generate engagement and proactiveness among site managers rather than reactive 'muddling through' patterns?

A significant concern in our data that seems to have an impact on practice outcomes relates to unexplored gender dimensions in construction research. Although Styhre (2011; 2012) explores and problematizes managerial work in relation to gender and masculinity, his perspective miss important aspects in terms of the embodied and 'sexed' nature of work and management. This relates to what Collinson and Hearn (1994) describe as a neglect of "naming men as men", i.e. the fact that men are often central to organisational analysis yet remain taken for granted, hidden and unexamined. This is a condition that emerged in our comparison. Our data suggest that practice outcomes seem to be influenced by expectations on the site manager's role as inherently embodied and occupied by a man. This shines through in manager B's account of how her enactment of paternalism seems to take on another meaning when performed by a woman. She felt that it gave her legitimacy and power, and she was able to influence her work in a significant manner. This process suggests that paternalism *per se* might not necessarily be an isolated gender predictor of work practices, but is as much influenced by the concrete, living and 'sexed' person filling the position.

If the concept of paternalism connotes a protective father who in turn asks for loyalty and obedience from the family members, how come that a woman filling the position of the "father" feel that she has an advantage in comparison to many men filling the same position? This notion might at first glance contradict the common view of women as generally disadvantaged in construction. However, following Connells' (2005) concept of hegemonic masculinity, we find indications that this is not necessarily the case. Suggesting that certain types of masculinity are elevated in working life and serves to uphold male-dominance and gender-segregation in organisations, Connell suggests that living up to the images of these traits serves as source of power and legitimacy. Here, it should be emphasised that hegemonic masculinity does not equal hegemony of all men. For instance, women who take on masculine traits and behaviours can gain more power and legitimacy than many men who do not live up to the hegemonic masculine ideal (Collinson and Hearn, 1994). However, by doing this the women confirm the hegemonic structure and contribute to

reproduce the ideals that segregate women in the industry. Or, alternatively, could it be that men take for granted the advantage of the paternal position? No matter what the verdict may be, we believe our findings warrant further empirical research and discussion.

These findings altogether highlight a need to further explore the embodied 'nature' of the industry, the work of site managers and the construction site at the intersection of micro and macro practices. Or more specifically, we need to examine how organizational elements (structures, cultures, processes and practices) becomes embodied and reified through the biographies and social identities of the people working in the industry. This is a direction that we hope to explore in the future.

REFERENCES

Applebaum, H A (1999) *Construction Workers*. Westport, USA: Greenwood Publishing Group.

Alvesson, M and Sveningsson, S (2003) Managers doing leadership: the extra-ordinarization of the mundane. *Human Relations*, 56(12), 1423-1459.

Cicmil, S and Marshall, D (2002) Insights into collaboration at the project level: Complexity, social interaction and procurement mechanisms. *Building Research and Information*, **33**(6), 523-535.

Collinson, D and Hearn, J (1996) *Men as managers, managers as men: Critical perspectives on men, masculinities and managements.* London: Sage Publications.

Connell, R W (2005) *Masculinities*. Oakland, CA: University of California Press.

Cox, A and Thompson, I (1997) 'Fit for purpose' contractual relations: Determining a theoretical framework for construction projects. *European Journal of Purchasing and Supply Management*, **3**(3), 127-35.

Djebarni, R (1996) Impact of stress on site management effectiveness. *Construction Management and Economics*, **14**(4), 281–93.

Dossick, C and Neff, G (2011) Messy talk and clean technology: Communication, problem-solving and collaboration using Building Information Modelling. *Journal of Engineering Project Organization*, **1**(2), 83-93.

Dubois, A and Gadde, L E (2002) The construction industry as a loosely coupled system: Implications for productivity and innovation *Construction Management and Economics*, **20**(7), 621-631.

Lindebaum, D and Cassell, C (2012) A contradiction in terms? Making sense of emotional intelligence in a construction management environment, *British Journal of Management*, **23**(1), 65-79.

Löwstedt, M and Räisänen, C (2014) Social identity in construction: Enactments and outcomes. *Construction Management and Economics*, **32**(11), 1093-1105.

Löwstedt, M (2015) 'Taking my glasses of in order to see': Exploring practice on a building site using self-reflexive ethnography. *Construction Management and Economics*, **33**(5-6), 404-414.

Mustapha, F and Naoum, S (1998) Factors influencing the effectiveness of construction site managers. *International Journal of Project Management*, **16**(1) 1-8.

Mäki, T and Kerosuo, H (2015) Site managers' daily work and the uses of building information modelling in construction site management. *Construction Management and Economics*, **34**(3), 1093-1105.

Ness, K (2010) Bringing order to chaos: The management of construction projects. In *The 5th Making Projects Critical Workshop, 20-22 January 2010, Bristol Business School.*

Polkinhorne, D (1995) Narrative configuration in qualitative analysis. *International Journal of Qualitative Studies in Education*, **8**(1), 5-23.

Sandberg, R, Raiden, A and Räisänen, C (2016) Workaholics on site! Sustainability of site managers' work situations? Forthcoming in *CIB World Building Congress, May 30-June 3 2016, Tampere, Finland.*

Styhre, A and Josephson, P-E (2006) The bureaucratization of the project manager function: The case of the construction industry. *International Journal of Project Management*, **24**(3) 271-276.

Styhre, A (2011) The overworked site manager: Gendered ideologies in the construction industry. *Construction Management and Economics*, **29**(9), 943-955.

Styhre, A (2012) Leadership as Muddling Through: Site Managers in the Construction industry. In Tengblad, S (Ed.) *The Work of Managers: Towards a Practice Theory of Management*. Oxford: Oxford University Press, 131-145.

Sveningsson, S, Alvehus, J and Alvesson, M (2012) Managerial leadership: Identities, processes, and interactions. *In*: S Tengblad (Ed.) *The Work of Managers: Towards a Practice Theory of Management.* Oxford: Oxford University Press, 69-86.

Tengblad, S (Ed.) (2012) *The Work of Managers: Towards a Practice Theory of Management* Oxford: Oxford University Press.

LIMINALITY ROLES IN CONSTRUCTION PROJECT PRACTICE: OPPORTUNITIES AND CHALLENGES

Tina Karrbom Gustavsson[1]

Real Estate and Construction Management, KTH Royal Institute of Technology, SE-100 44, Stockholm, Sweden

Project management handbooks and courses teach structured and standardized ways of organizing and managing projects, including clearly defined project roles. However, projects are no isolated islands and projects in practice continuously develop and change. This is the case in, for example, the project based construction industry, and in which new inter organizational and collaborative work practices have become increasingly common. This paper is based on two case studies and explores developments and changes in construction project practice, in particular the development of new roles. The concept of liminality is used as analytical lens to better understand these new roles. Findings show new and challenging multi liminal roles that origin from other knowledge domains and professional communities of practice, than what is traditional in construction project management. This development poses both opportunities and challenges for the individual project worker and the development of construction industry practices.

Keywords: projects, construction project work, roles, liminality

INTRODUCTION

There has been a standardization and professionalization process going on within project management during the last decades (Hodgson and Cicmil, 2006, Karrbom Gustavsson and Hallin, 2014). The process includes, for example, certification of project managers and definitions of standardized project processes and roles.

However, no project is an island (Engwall, 2003), and processes and roles continuously develop and change in day-to-day-project practice. This is the case in, for example, the construction industry; an industry that has a reputation of being in efficient, conservative and reluctant to changes (Styhre, 2010, 2012), but which is currently undergoing changes related to, for example, collaborative approaches (Bygballe *et al*., 2010; Eriksson 2010), supply chain integration (Eriksson, 2015a), and digitalisation, in particular on Building Information Modelling (BIM) (Fox, 2014; Gilkingson *et al*., 2015; Jacobsson and Linderoth, 2012; Karrbom Gustavsson *et al*., 2012).

What standardized project roles include is thus clearly defined in handbooks, but how roles develop and change over time, and from where they origin is less known. The research question is thus twofold: What new roles have developed in construction project practice, and from which knowledge domains and professional communities do they origin? The findings are based on two case studies from contemporary

[1] tina.karrbom@abe.kth.se

Karrbom Gustavsson, T (2016) Liminality Roles in Construction Project Practice: Opportunities and Challenges. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 689-698.

construction practice in Sweden: a collaborative construction project and a process innovation development project performed within an urban development project. The concept of liminality is used as analytical lens to interpret the development and associated opportunities and challenges in relation to the new roles. Liminality, meaning "betwixed and between" (Turner, 1967, in Beech, 2011), is commonly taken to mean a position of ambiguity and uncertainty (Beech, 2011).

The findings contribute to the growing literature on projects as continuously changing processes and practices (Blomqvist *et al*., 2010; Cicmil *et al*., 2006) and have implications for construction project management literature (Gould and Joyce, 2011; Winch, 2010). The findings provide better understanding of how project practices and roles continuously change and develop and what opportunities and challenges that follows. The findings show, for example, that the development of new multi liminal roles poses challenges to the already complex work situation of the individual project worker (Zika-Viktorsson *et al*., 2006; Karrbom Gustavsson, 2016). The findings also provide insights into the opportunities and challenges of challenging construction industry practice, norms and heuristics (Eriksson, 2016; Styhre, 2010).

Before presenting the method and data, projects, and in particular construction projects and associated roles are presented. Then follows a description of the concept of liminality, including how it may serve as analytical lens. The paper ends with findings and discussion.

PROJECTS

Projects are temporary organizational constructs that are continuously developing and embedded in multiple contexts (Engwall, 2003; Lundin and Söderholm, 1995). A project can therefore be understood and studied as a contextual process of change (Maaninen-Olsson and Müllern, 2009); a process that includes for example transitions between phases/stages (van den Ende and van Marrewijk, 2014), coordination and communication within and between actors (Dainty *et al*., 2006), establishing relationships and routines (Eriksson, 2015b), and the change of roles and responsibilities (Karrbom Gustavsson, 2015). Project work is challenging as it includes making sense of one's own work as well as the work of others while working in turbulent and constantly changing work contexts (Weick, 1995).

Construction project practice

There has been an increased interest in collaborative and innovative approaches in construction project practice during the last decades (Bygballe *et al*., 2010; Eriksson, 2010; Walker and Jacobsson, 2014). These approaches include, for example, the development and implementation of new procurement strategies for integrating supply chains (Eriksson, 2015a) and the development of new process innovations (Eriksson and Karrbom Gustavsson, 2016). These approaches challenge traditional relationships (Kadefors, 2004), heuristics (Eriksson, 2016), and industry norms (Styhre, 2010). Collaborative approaches, integrated supply chains and digitalisation are three examples of contextual factors that drive change and challenge traditional work practices and roles in construction projects (Karrbom Gustavsson, 2015).

This development has made construction projects become increasingly complex (Chan *et al*., 2004, Walker and Jacobsson, 2014). The complexity includes not only technical issues but also the reciprocal interdependencies between processes, phases and/or stages and actors (Marshall and Bresnen, 2013) and put pressure on, for example, coordinating, integrating and managing the large number of actors that are

involved (Walker and Jacobsson, 2014). At the same time, this development challenge traditional knowledge domains and professional communities of practice (Wenger, 1998).

Construction project roles

Roles in construction project management literature are often defined from a stakeholder perspective. For example: clients, designers, contractors and specialist suppliers (Winch, 2010, 22), or owners, design professionals, construction professionals, material suppliers and equipment suppliers (Gould and Joyce, 2011, 25-41). Previous studies of specific project roles in construction have focused on, for example, the "overworked site manager" (Styhre, 2011) that is "stuck in the middle" (Styhre and Josephson, 2006) and their daily work and use of BIM (Mäki and Kerosuo, 2015). The construction project managers, and their "leadership competences" (Tabassi *et al*., 2016), "key social competences" (Zhang *et al*, 2013), and other characteristics, have also gained much attention.

There is less literature on, for example, partnering managers or BIM managers, except for a few recent practical handbooks. This is despite the fact that partnering projects have been popular for more than a decade and still is becoming increasingly more common (Eriksson, 2010). The implementation of BIM has also increased in construction project practice and is now on top of the agenda for many construction companies (Karrbom Gustavsson, *et al*., 2012).

LIMINALITY

The word liminal originates from limen, which is the Latin word for threshold. "The word denotes rituals of transition – of passage between one social status to another" (Czarniawska and Mazza, 2003, 269). Turner (1982) notes that it is the blurring and merging of distinctions that characterize liminality. He claims that persons who find themselves in a liminal phase, for example when changing roles or developing practices, are "temporarily undefined, beyond the normative social structure. This weakens them, since they have no rights over others. But it also liberates them from structural obligations" (Turner, 1982, 27 in Czarniawska and Mazza, 2003, 271).

Liminality as process, position or space

The concept of liminality has traditionally been used in three ways in management and organization studies: as process, position or space (Borg, 2014).

Liminality as a process refers to a change process for individuals and organizations, for example during development and training programs (Eriksson-Zetterquist, 2002) and organizational change periods (Czarniawska and Mazza, 2003).

Liminality as a position focus on the individual and certain positions that are liminal and cause individuals to be betwixt and between, i.e. of belonging and of being different at work. This liminality originates from the individual's experiences of professional belonging and identities, which puts individuals between different professional communities. Holding liminal positions with liminal professional identities provides the individual with freedom to move between professional communities (Zabusky and Barley, 1997, in Borg 2014) and to act as negotiator between communities (Jeraraj, 2004, in Borg 2014).

Individuals who temporarily work in an organisation to which they have no formal belonging can also hold liminal positions. They are betwixt and between traditional structures of work and face structural ambiguity (Borg, 2014). These positions

include, for example, temporary workers (Garsten, 1999), consultants (Czarniawska and Mazza, 2003) and project workers (Sturdy *et al*., 2009). Liminal positions offer both positive and negative implications for the liminars (Borg, 2014). For example: on the positive site it has offered more mobility and freedom from obligations, which can trigger innovative thinking and the access and assembly of different disciplinary knowledge. On the negative site, people that hold liminal positions can experience a weakening of power and exclusion from organizational resources, privileges and information.

Liminality as space emphasizes geographical places created as liminal scenes where different logics meet and create ambiguity. It can be, for example, routines, norms, and activities that meet and are renegotiated (Borg, 2014).

METHOD

The approach is qualitative and based on two longitudinal cases (Yin, 2009). The purpose is to contribute to existing literature. The first case study was conducted between 2011 and 2013 and includes observations, meetings and workshops, document analysis, and 14 semi-structured interviews with project members. The project was comprised of a large office building, including an assembly hall and restaurants, with innovative and complex structure and design and a tight construction site putting pressure on, for example, the coordination of suppliers. The project was a high profile collaborative construction project and the building was going to serve as a landmark for the area.

The second case study was conducted between 2015 and 2016 (the study is still partly on-going) and includes observations, seminars and workshops, document analysis and 17 semi-structured interviews with project members. The project is comprised of an urban development project, including several housing and infrastructure projects that will be performed in sequences. Integrated in the urban development projects is also the development of a process innovation, a logistic centre, which will serve all contractors and subcontractors during construction. The ambitions are that the urban development project will serve as role model for future sustainable urban development.

Literature and data have challenged each other during the interpretation process in what Dubois and Gadde (2002) would call an “abductive” process. The interpretation process began with the first case and resulted in tentative findings that were presented at a conference (Karrbom Gustavsson, 2015). Later followed the second case, including an inductive-based search for similar patterns and themes. The whole process was based on thematic content analysis (Bryman, 2008), where inter organizational challenges and boundary spanning actions and roles are examples of themes that developed already during the analysis of the first case. Interpretative case studies are recommended when the aim is to understand processes and practices (Linderoth and Jacobsson, 2008), and they are especially appropriate to develop a deeper understanding of how and why processes develop and evolve over time (Langley, 1999). The selection of cases was based on expert sampling, in combination with possibilities to gain access to sites, project managers and project members.

This method has its limitations. It is only two cases, they are different in size and scope, and the focus has been on new roles, origin from other professional communities of practice. There were of course developments and changes also in

other project roles. The new roles are however of special interest since they challenge traditional construction practices and roles.

FINDINGS

Construction projects are performed under multiple constraints. For example time and cost, as well as technical, contextual and organizational complexity, which the project members continuously strive to make sense of in their daily work practices. While project handbooks argue for standardized roles, the cases studied show that clients have added new roles and new competence to the projects. Here, the new roles will be presented.

New roles in construction projects

When construction project work is performed, individuals perceive and encounter various challenges and opportunities. This is displayed, for example, by the three liminal roles that were developed in the two studied cases: "The partnering manager", "the logistics specialist" and "the BIM manager".

"Partnering manager"
The client in the office building-project contracted a consultant during the design phase to serve as "a third independent party" between the client and the main contractor. This consultant, who was called "partnering manager", had some previous experience of working in construction projects, in particular with focus on installation works. The consultant had also been educated in social sciences, and had a special interest and competence in group-processes. The partnering manager's work included, for example, interviewing and recommending new project members to the client's project manager, managing the collaboration process by selecting, presenting and following up various collaboration tools (for example a mutual goal agreement and a repetitive collaboration satisfaction survey), and by designing, facilitating and following up collaboration activities (for example collaborative workshops and social events). The partnering manager described the work as "helping the project meeting its goals".

"Logistics specialist"
The urban development project has a strong environmental profile and in order to minimize transports in the tight urban area and meet the goals of, for example, reduction of green-house-gases, a logistic centre, which is mandatory to use by all contractors and subcontractors, has been contracted and established in the area. The logistic centre's activities are designed, promoted and enacted by the "logistics specialist" who have experience and education in logistics and IT from the automotive industry. The logistics specialist's work includes, for example, introducing the idea and practices of the logistic centre, support project members with expertise in logistics and to help coordinating, for example, project actors, material transports, production and delivery plans, as well as waste, equipment, and machinery. The logistics specialist described the work as "support to the projects" integrating their construction work with the supply chain to enable a more efficient construction process. The project actors, on the other hand, had mixed perceptions of the daily work of the logistics specialist; some viewed the work as contributing to a more efficient project process, while others viewed the work a hinder from doing their work according to common ways of working.

"BIM manager"
In the office building-project, with innovative and challenging structure and design, 3D-object based modelling, or BIM, was implemented for visualisation, calculations, simulations, clash detection etc. The client contracted a consultant with experience in digital modelling and of being a specialist in BIM (Building Information Modelling). The consultant was contracted already during early design phase to act as "BIM manager" throughout the project. The work was comprised of supporting, or "helping and combining the actors", as the BIM manager described it, by coordinating the different designer's design work and integrate their respective design models into one joint 3D project model. The BIM manager thus performed the integrative work, combining all the design professions and design practices and their performances before handing the project model over to the contractor at the start of construction work.

DISCUSSION

The three roles: "Partnering manager", "logistical specialist" and "BIM manager", are examples of roles that have become increasingly common in construction projects due to the increased focus on collaborative, innovative, inter organizational and digital approaches. All new roles are client initiatives to handle challenges and take advantage of opportunities in collaboration, supply chain and information technology. The client initiatives can also be seen as a trend that to include new competences and challenge traditional practices.

Intermediators

The new roles can be interpreted as, for example, change agents, boundary brokers or spanners that are contracted to drive change in construction project practice and as intermediators, filling professional and organizational gaps, or "in-betweens" in project practice. As intermediators, the "partnering manager" performs intermediation between client and contractor when facilitating interactive workshops, the "logistics specialist" performs intermediation between the construction project's ways of working and the supply chain's ways of working, and the "BIM manager" performs intermediation between both the different design professions and the contractor when integrating their respective models into one project model and between different phases when developing a model that can be used in both design, production and operation.

However, the intermediators do more than that in their daily work: They also challenge traditional work practices and professional communities of practice by their existence. They also challenge heuristics and norms by performing their work based on knowledge, language and experience from other professional communities (other scientific fields and other industry contexts). Thus, while performing daily work, they pose both opportunities and threats to the traditional roles, routines and structures within construction project practice.

Liminality and new project roles

There are several studies focusing on the temporary worker, often working "in-between" or as Turner (1982, 27) puts it: being "betwixed and between". For the individual project worker, this means to work in a position of ambiguity and uncertainty (Beecht, 2011). The conceptual lens of liminality is helpful for increasing our understanding of the new project roles in construction projects. It is also of value for taking the individual project worker's working conditions as an intermediator

seriously. Being an intermediator, as described above, means the combination of liminality as a process, a position and space.

Liminality as a process means that the new roles have to adjust and handle a constantly changing industry context due to, for example, global market trends, digitalisation of society and sustainability demands.

Liminality as a position means that the new roles are consultancy roles, which includes specific competence that pose a threat to traditional work practices.

Liminality as space means that the new roles share geographical spaces such as collaborative workshops, logistic centres, and virtual integration with integrated models.

Thus, project practice for "partnering managers", "logistics specialists" and "BIM managers" does not only mean being "in-between" actors, heuristics or professions, or being in liminality as a process, a position or a space. The new roles that are developing in construction project practice become even more complex: when they perform work in project practice, they are practicing all three liminality dimensions at the same time – they practice multiple "in-betweenness", or multiple liminality (Borg, 2014; Czarniawska and Mazza, 2003).

There is a risk of individuals perceiving project overload (Zika-Viktorsson, 2006; Karrbom Gustavsson, 2016), and/or being in "limbo" (Turner, 1982, 24) when practicing multiple liminality. This risk does, however, also pose opportunities for project practice to evolve outside the heartlands of traditional construction project heuristics. This calls for more longitudinal studies of developing and changing roles and practices to determine how they actually change and how the incorporation process can be facilitated.

CONCLUSIONS

Practices and roles develop and change in construction project practice. This development is taking place through new ways of interacting and organizing project work and by contracting competences from other professional communities of practice. The partnering manager had specialised in social sciences, the logistical specialists had specialised in logistics and the BIM manager had specialised in information technology. These roles – and competences – pose challenges for the individual project worker and also opportunities for the development of construction industry. Previous organisation and management studies on liminality stress that liminality is either a process, or position, or space. This study shows that new roles perform a combination of all three of these: limiality as a process, liminality as a position and liminality as space. This finding contributes with new knowledge on project organising: organising as enacting multiple liminalities, and despite its limitations, this study show that there is need for more in-depth-studies taking processual perspectives on project organising in order to better understand the dynamic, challenging and evolving nature of project as practice.

REFERENCES

Beech, N (2011) Liminality and the practices of identity construction. *Human Relations*, **64**(2), 285-302.

Blomquist, T, Hällgren, M, Nilsson, A and Söderholm, A (2010) Projects-as-practice: In search of project management research that matters. *Project Management Journal*, **41**(1), 5-16.

Borg, E (2014) *Liminality at work Mobile Project Workers In-Between*. PhD Thesis, No 614, Linköping Studies in Arts and Science, Department of Management and Engineering, Linköping University.

Bygballe, L E, Jahre, M and Swärd, A (2010) Partnering relationships in construction: A literature review, *Journal of Purchasing and Supply Management*, **16**(4), 239-53.

Bryman, A (2008) *Social Research Methods 3rd Edition*. Oxford: Oxford University Press.

Chan, A P C, Chan, D W M, Chiang, Y H, Tang, B S, Chan, E H W and Ho, K S K (2004) Exploring critical success factors for partnering in construction projects. *Journal of Construction Engineering and Management*, **130**(2), 188-198.

Cicmil, S, Williams, T, Thomas, J and Hodgson, D (2006) Rethinking project management: Researching the actuality of projects. *International Journal of Project Management*, **24**(8), 675-686.

Czarniawska, B and Mazza, C (2003) Consulting as a liminal space. *Human Relations*, **56**(3), 267-290.

Dainty, A, Moore, D and Murray, M (2006) *Communication in Construction*. New York, NY: Taylor and Francis.

Dubois, A and Gadde, L-E (2002) Systematic combining: An abductive approach to case research. *Journal of Business Research*, **55**(7), 553-560.

Engwall, M (2003) No project is an island: Linking projects to history and context. *Research Policy*, **32**(5), 789-808.

Eriksson, P E (2010) Partnering: what is it, when should it be used, and how should it be implemented? *Construction Management and Economics*, **28**(9), 905-917.

Eriksson, P E (2015a) Partnering in engineering projects: Four dimensions of supply chain integration. *Journal of Purchasing and Supply Management*, **21**(1), 38-50.

Eriksson, T (2015b) Developing routines in large inter-organisational projects: A case study of an infrastructure megaproject. *Construction Economics and Building*, **15**(3), 1-16.

Eriksson, T (2016) *Designing the Design Organization Client-Consultant Coordination in a Large Infrastructure Project*. PhD Thesis, Division of Service Management and Logistics, Chalmers University of Technology, Gothenburg, Sweden.

Eriksson, P E and Karrbom Gustavsson, T (2016) *Upphandlingsstrategier för utmanande projektförutsättningar i trånga innerstadsprojekt En vägledning till byggherrar i Norra Djurgårdsstaden* Rapport, Stockholms stad (in Swedish)

Eriksson-Zetterquist, U (2002) *Casting the Other Production and Maintenance of Inequality In Organizations*. London: Routledge.

Fox, S (2014) Getting real about BIM. *International Journal of Managing Projects in Business*, **7**(3), 405-422.

Garsten, K (1999) Betwixt and Between: Temporary employees as liminal subjects in flexible organizations. *Organization Studies*, **20**(4), 601-617.

Gilkingson, N, Pathmeswaran, R, Kiviniemi, A and Chapman, C (2015) Building information modelling: The tide is turning. *Proceedings of the Institution of Civil Engineers: Structure and Buildings*, **168**(2), 81-93.

Gould, F and Joyce, N (2011) *Construction Project Management 3rd Edition*. London: Pearson Education.

Hodgson, D and Cicmil, S (2006) Are projects real? The PMBOK and the legitimation of project management knowledge. *In*: D Hodgson and S Cicmil (Eds.) *Making Projects Critical*. New York: Palgrave.

Jacobsson, M and Linderoth, H C J (2012) User perceptions of ICT impacts in Swedish construction companies: 'it's fine, just as it is'. *Construction Management and Economics*, **30**(5), 339-357.

Kadefors, A (2004) Trust in Project Relationships: Inside the Black Box. *International Journal of Project Management*, **22**(3), 175-82.

Karrbom Gustavsson, T and Gohary, H (2012) Boundary action in construction projects: new collaborative project practices. *International Journal of Managing Projects in Business*, **5**(3), 364-376.

Karrbom Gustavsson, T, Samuelson, O and Wikforss, Ö (2012) Organizing IT in construction: Present state and future challenges in Sweden. *Journal of Information Technology in Construction*, **17**, 520-534.

Karrbom Gustavsson, T and Hallin, A (2014) Rethinking dichotomization: A critical perspective on the use of "hard" and "soft" in project management research. *International Journal of Project Management*, **21**(4), 568-577.

Karrbom Gustavsson, T (2015) New boundary spanners: Emerging management roles in collaborative construction projects. *Procedia Economics and Finance*, **21**, 146-153.

Karrbom Gustavsson, T (2016) Organizing to avoid project overload: The use and risks of narrowing strategies in multi project practice. *International Journal of Project Management*, **34**(1), 94-101.

Langley, A (1999) Stratgegies for theorizing from process data. *Academy of Management Review*, **24**(4), 691-710.

Lundin, R A and Söderholm, A (1995) A theory of the temporary organization. *Scandinavian Journal of Management*, **11**(4), 437-455.

Marshall, N and Bresnen, M (2013) Where's the action? Challenges of ethnographic research in construction. *In*: S Pink, D Tutt and A Dainty (Eds.) *Ethnographic Research in the Construction Industry*. New York: Routledge.

Maaninen-Olsson, E and Müllern, T (2009) A contextual understanding of projects: The importance of space and time. *Scandinavian Journal of Management*, **25**(3), 327-339.

Mäki, T and Kerosuo, H (2015) Site manager's daily work and the uses of building information modelling in construction site management. *Construction Management and Economics*, **33**(3), 163-175.

Styhre, A and Josephson, P-E (2006) Revisiting the site manager work: Stuck in the middle? *Construction Management and Economics*, **24**(5), 521-528.

Styhre, A (2010) In the circuit of credibility: construction workers and the norms of 'a good job'. *Construction Management and Economics*, **29**(2), 199-209.

Styhre, A (2011) The overworked site manager: gendered ideologies in the construction industry. *Construction Management and Economics*, **29**(9), 943-955.

Styrhe, A (2012) Leadership as muddling through: Site managers in the construction industry. *In*: S Tengblad (Ed.) *In the Work of Managers: Towards a Practice Theory of Management*. Oxford: Oxford University Press, 131-145.

Sturdy, A, Clark, T, Fincham, R and Handley, K (2009) Between innovation and legitimation-boundaries and knowledge flow in management consultancy. *Organization*, **16**(5), 627-653.

Tabassi, A A, Roufechaei, K M, Ramli, M, Bakar, A H A, Ismail, R and Pakir, A H K (2016) Leadership competences of sustainable construction project managers. *Journal of Cleaner Production*, **124**(15), 339-349.

Trice, H M and Beyer, J M (1993) *The Cultures Of Work Organisations*. Englewoods Cliffs, NJ: Prentice Hall.

Turner, V (1967) *The Forest of Symbols: Aspects of Ndembu Ritual*. Ithaca, NY: Cornell University Press.

Turner, V (1982) *From Ritual To Theatre: The Human Seriousness At Play*. New York: Performing Arts Journal Books.

Van den Ende, L and van Marrewijk, A (2014) The ritualization of transitions in the project life cycle: A study of transition rituals in construction projects. *International Journal of Project Management*, **32**(7), 1134-1145.

Walker, D and Jacobsson, M (2014) A rationale for alliancing within a public-private partnership Engineering. *Construction and Architectural Management*, **21**(6), 648-673.

Weick, K (1995) *Sensemaking in Organizations*. Thousand Oaks, CA: Sage Publications.

Wenger, E (1998) *Communities of Practice, Learning, Meaning and Identity*. Cambridge: Cambridge University Press.

Winch, G (2010) *Managing Construction Projects*. Hoboken, NJ: John Wiley and Sons.

Yin, R K (2009) *Case Study Research: Design And Methods 4th Edition*. Thousand Oaks, CA: Sage Publications.

Zhang, F, Zuo, J and Zilante, G (2013) Identification and evaluation of the key social competences for Chinese construction project managers. *International Journal of Project Management*, **31**(5), 748-759.

Zika-Viktorsson, A Sundström, P and Engwall, M (2006) Project overload: An explanatory study of work and management in multi-project settings. *International Journal of Project Management*, **24**(5), 385-394.

THE ROLE OF LEARNING IN CONSTRUCTION TECHNOLOGY TRANSFER: A 'SCOT' PERSPECTIVE

Kwadwo Oti-Sarpong[1] and Roine Leiringer

Department of Real Estate and Construction, Faculty of Architecture, The University of Hong Kong, Pokfulam Road, Hong Kong

Technology transfer (TT) has been given increasing importance since the formulation of the international code of conduct for technology transfer by the UNCTAD in 1985, and has become a preferred medium to bridge development gaps between developed and developing countries. Concomitantly, international joint ventures (IJVs) have been put forward as vehicles for change in the belief that contractors in developing countries can position themselves to receive technology from their developed counterparts. So far, TT has been studied through a variety of theoretical lenses. However, predominantly, the perspectives taken have assumed a linear process, viewing technology merely as an object, and effectively disregarding the multiple interactions involved in TT. In this paper, we argue that such perspectives only provide partial explanations of what construction technology entails, and how it is transferred between organisations. A counter-argument is put forward to view TT as a process of socio-technical interactions that is reliant on learning. Adopting the theoretical lens of the Social Construction of Technology (SCOT), we show how the SCOT framework allows for examining the socio-technical interactions between human actors and construction technology in TT. Specifically, we use the SCOT constructs of 'interpretative flexibility' and, 'closure and stabilisation' to reveal how learning is an integral process within the socio-technical interactions, which plays a critical role in TT between contractors in IJVs. Conclusions are drawn, highlighting the importance of studying TT as a system of socio-technical interactions on a construction project, in order to understand how learning plays a role in the process.

Keywords: developing countries, international joint ventures, learning, social construction of technology, technology transfer

INTRODUCTION

Contractors in developing countries lack in technology needed to undertake the usually large and complex construction infrastructure projects that are vital for their countries' development (Devapriya and Ganesan 2002; UNCTAD 2014). These infrastructure projects include hospitals, highways, dams, harbours, airports, water processing facilities, power plants and, oil and gas processing plants. Through international tendering, contractors from developed countries are able to compete for, and win most of these projects, because they have the requisite technology (Osabutey *et al*., 2014). This contributes to the creation of a vicious cycle of technology gaps between contractors in developing countries and their counterparts from developed countries. The persistence of this cycle further promotes an unhealthy dependence by

[1] kotisarp@connect.hku.hk

Oti-Sarpong, K and Leiringer, R (2016) The Role of Learning in Construction Technology Transfer: A 'Scot' Perspective. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 699-708.

developing countries on foreign contractors to deliver their key infrastructure projects (Ofori 1994).

As part of global effort to narrow technology gaps between developed and developing countries, the United Nations Conference on Trade and Development (UNCTAD) introduced Technology Transfer (TT) as an alternative to foreign direct investment in 1985. Essentially, the UNCTAD suggests that TT should be arranged according to the levels of economic development, infrastructure gaps and technological deficits between developed and developing countries (UNCTAD 2014). The United Nations further suggested international joint ventures (IJVs) as potentially effective channels for TT into developing countries (ibid.). IJVs are, indeed, reportedly the most preferred medium for the transfer of construction technology into developing countries (Ofori 1994; Wahab *et al*., 2012b; Chrysostome *et al*., 2013; Osabutey *et al*., 2014). The contractors there are less advanced, hence IJVs provide an enabling environment for close assistance, which is vital for them to learn in the process of TT (Manimala and Thomas 2013; UNCTAD 2014).

Notwithstanding the strong arguments for why TT into developing countries should be achievable through IJVs, there are ample examples of where this has not turned out to be the case. For example, the World Bank undertook a number of construction projects (e.g. roads, drainage and water treatment plants) in developing countries from the early 1980s to the late 1990s, mainly through IJVs (Haug 1991; Ayittey 2002; Estache 2005). One of the main intentions behind the formation of IJVs, was to facilitate TT. This ambition was, however, largely unrealised (Haug 1991; Devapriya and Ganesan 2002; Estache 2005). In recent times, countries like Ghana, Nigeria, Tanzania and South Africa have attempted to improve their local contractors through TT, by forming IJVs with foreign contractors to undertake construction projects. These attempts are based on the intention of having some technology transferred to their local contractors as they work with foreign contractors on the projects (Rwelamila and Mkandawire 2013; Osabutey *et al*., 2014). However, many of such TT attempts are reported to have failed.

The failure of TT attempts into developing countries is, at least partly, a result of an erroneous assumption that foreign contractors transfer technology to local contractors once they merely work together on a project; and that local contractors already possess the capabilities and skills that will enable them to receive technology from foreign contractors. Furthermore, it can be argued that early attempts of TT were generally based on a narrow consideration of the concept of technology and the process of TT itself. With construction technology commonly linked to tangible artefacts, tools, equipment or machinery, the related assumption is that TT is a linear process of transferor-transferee relations; merely passing on machinery between the parties (Ofori 1994; Abbott *et al*., 2007; Rwelamila and Mkandawire 2013). Considering construction technology and its transfer in this mechanistic view neglects the series of socio-technical interactions involved in the transfer process between the IJV contractors (cf. Williams and Edge 1996; Manimala and Thomas 2013).

In this paper, we first present technology from a social constructionist perspective, and show how its transfer in construction can be seen as a system of socio-technical interactions between contractors in IJVs. We then go on to argue that learning is an intrinsic component within the social shaping of technology and socio-technical interactions, and that it plays a critical role in the process of TT. We begin by setting out technology from a social construction position, against traditional views. TT is

then presented as system of socio-technical interactions with learning as a critical component for its success. The social construction of technology (SCOT) is then presented as a theoretical framework to be used in exploring the complexities of TT under IJV arrangements. The SCOT constructs of 'interpretative flexibility' and 'closure and stabilisation' are used to present learning as a key to successful TT.

Technology and Technology Transfer

What is technology?

Providing a single definition for ‘technology’ is difficult owing to its extensive application in different areas (Wahab *et al*., 2012a). Its root word ‘techne’, means to bring forth the essence of a thing in its true form; meaning that technology goes beyond tangible products or artefacts. In the extreme, technology is considered as a means to drive reality. It encompasses a way of thinking and a style of practice that goes beyond the physical to something intuitive (cf. Heidegger 1977). Hence, technology should not be conceptualised distinctively as an artefact or process only, detached from the social interactions related to its development (Williams and Edge 1996; Elle *et al*., 2010).

Early definitions of technology can be broadly grouped under: product, process and management technology. Recent literature categorises technology as ‘hard’/ ‘explicit’ or ‘soft’/ ‘tacit’, with definitions characterized by key elements such as: knowledge, physical artefacts, systems and processes, and managerial expertise (Wahab *et al*., 2012a). Related to this, technology is generally considered to comprise four closely linked components: knowledge; technique; products and the organization involved. 'Knowledge' refers to the explicit facts and embedded experiences associated with technology, and is as such an intrinsic component of technology. 'Technique' refers to the practical methods, skills and processes deployed in conjunction with knowledge and physical 'products' towards realising a desired outcome. The 'organisation' is the immediate context which hosts the interactions between the other three components of technology (Gorman 2002; Ismail *et al*., 2009). One widely held perspective portrays technology distinctively as either an artefact/product, or a set of rules and patterns of actions (Wahab *et al*., 2012a). Such compartmentalised views effectively disregard the complexity of the social construction and socio-technical interactions in what constitutes technology (Williams and Edge 1996) and subsequently, its transfer. This, in turn, leads to a limited representation of the composition of technology, and also constrains the extent to which the complexities involved in its transfer can be explored.

A handful of recent studies on construction technology have argued for a more comprehensive approach in conceptualising technology, and its uptake between organisations (Harty 2005; Ismail *et al*., 2009; Schweber and Harty 2010; Boyd *et al*., 2015). Technology in this sense is viewed as being socially constructed. It is developed through a series of interactions, leading to modifications and alterations in the technology, and the various actors involved in a context. It is a composition of explicit (e.g. machinery, plant and equipment, tools and devices) and tacit components (e.g., knowledge, intuitive ideas, experience and skills) that are developed through series of interactions with human actors, and shaped towards a desired outcome (see Pinch and Bijker 1984). From this view, these components of a technology are inseparable. They are all in a constant relationship through series of actors’ negotiations, influencing and modifying each other (Williams and Edge 1996). Hence, technology is socially constructed through a series of socio-technical

interactions. It is, as such, not socially neutral. Rather it is a product of socio-technical interactions and social shaping in a specific context (Williams and Edge 1996; Elle *et al*., 2010). Based on the above, we consider 'Technology' as comprising: tangible and intangible components, as well as systems or processes that interact with human actors towards an intended, specific output. This composition varies across contexts, and undergoes series of modifications as it is developed and moved from one place to another, to be re-developed and re-shaped socially through a series of interactions.

Technology transfer

There are many definitions of technology transfer owing to the different meanings ascribed to technology (Wahab *et al*., 2012a; Manimala and Thomas 2013). Generally, definitions emphasise that TT is neither merely handing over documented information, nor a simplistic sale of machinery to a transferee. It is a collaborative process that requires a sustained, close relationship between the parties involved over a period (Wahab *et al*., 2012b; Manimala and Thomas 2013; UNCTAD 2014). Here we position 'Technology Transfer' as a deliberate process through which technology is moved from one party to another through series of interactions, within a specific channel towards an intended outcome.

TT is a process that unfolds over a period of time, comprising a series of interactions between: the transferor, the technology, the transferee, the channel/vehicle of transfer, and the context of transfer. The process can be either intra- or inter organisational, based on the direction of the transfer. It may be categorised as local or international, based on the home countries of the firms involved. The transferor is the primary entity in possession of a relatively stabilized technology desired by others, and the transferee is the entity which receives technology from the transferor. The process of TT can however be bi-directional as the transferor and transferee positions are not fixed throughout the period of interactions. The channels of transfer are the intermediary conduits, modes and agents which facilitate the transfer process, generally referred to as ‘vehicles of transfer’. Popular TT channels in construction include subcontracting and joint venture arrangements (Wahab *et al*., 2012b).

A Socio-Technical Perspective of Construction Technology and Its Transfer

Broadly, construction technology refers to any form of technology used by construction firms towards the delivery of a construction product. Generally, it consists of tacit and explicit technology, with the tacit form being most difficult to transfer. Tacit technology refers to the embedded, intangible assets of an organisation, such as skills, operational and experiential knowledge, production methods, systems and processes, and management ideas and skills. Its transfer is considered largely impossible without person-to-person interactions between transferor and transferee (Manimala and Thomas 2013). Explicit technology, on the other hand, is the tangible machinery, tools or equipment that are guided by knowledge to produce desired results (Ismail *et al*., 2009). These two broad aspects of technology are constantly developed, modified and used on construction projects by human actors. During construction project execution, contractors employ a combination of tacit and explicit technology. These include construction plant and equipment, project techniques, construction and management processes, as well as intuitive ideas that are incorporated in a project design, and managing construction processes (Harty 2005; Ismail *et al*., 2009).

It follows from the above that, the process of project delivery involves a series of socio-technical interactions between human actors and technology. As part of the interactions, technology is 'socially constructed' (i.e., modified by actors to suit their respective organisational and contextual requirements for effective utilisation). The interactions lead to the creation of a technological system, which is used in delivering construction products such as buildings, bridges, dams or harbours (Schweber and Harty 2010). Despite the foregoing, TT in construction has been generally conceptualised as a linear process (e.g., Ofori 1994; Abbott *et al*., 2007). Accordingly the transferee identifies the desired technology and its owner, after which arrangements are made for its transfer. Over a trial and re-trial period, the transferee is able to make adjustments to the technology to suit their operations. This approach fails to put in perspective the inter-organisational and socio-technical interactions that take place during the transfer process, as well as the social shaping of the technology involved. Hence, the relationship between the nature of the technology being transferred, the context of the transfer and, the interactions of the actors involved (with themselves, as well the machinery, systems or processes of technology) are subsequently neglected.

Reflecting on the nature of construction technology, TT is neither the mere act of transferring proprietary documented information from one organisation to another, nor transferring a piece of hardware from one location to another. The process involves a series of socio-technical interactions between the actors and the technology involved (Wahab *et al*., 2012b; Manimala and Thomas 2013). These interactions introduce adjustments, modifications and alterations in the organizations involved. These changes contribute to the abilities of the TT parties to receive and incorporate new technology into their organisational practices and routines. Few studies in construction research have adopted a socio-technical perspective on technology, focusing mainly on intra-organisational analysis of technology adoption (e.g. Schweber and Harty 2010, Sackey *et al*., 2014; Boyd *et al*., 2015), adoption of smart electricity meters in domestic buildings (Skjølsvold and Ryghaug 2015), and systems building in the use of 3D CAD technology in construction (Harty 2005). The socio-technical view in technology studies presents a coherent and inclusive approach to examine the complex realities of interactions between people, technology and organizations. It puts into perspective the co-development of the parties involved, and the modification of technology in the process of its transfer within a defined social context (Schweber and Harty 2010). This view helps to explain the series of interactions between actors in a defined context, and in turn the multiple interactions that influence technology development and uptake, or transfer (Harty 2005; Sackey *et al*., 2014).

As TT actors shape technology within their social and organisational contexts, and are themselves modified by the technology through socio-technical interactions, there is the revision of old, and/or, development of new knowledge. This is reflective of learning (see Huber 1991; Schilling and Kluge 2009). Additionally, the processes of alteration and adjustment by TT parties in order to transfer and/or receive technology is indicative of a learning process. Thus, we argue that within the series of socio-technical interactions of TT, there is a component of learning which plays an essential role in the outcome of TT. Related to this, some studies (e.g. Manimala and Thomas 2013; Chrysostome *et al*., 2013) have intimated that learning is a critical component in TT.

Technology Transfer and Learning

Historically, the transfer of agricultural, military and construction technology between parties involved close interpersonal relationships. These relationships allowed the parties to spend sufficient time with each other, in order to learn as part of the transfer process (Gorman 2002).

The process of TT as a series of socio-technical interactions leads to inter and intra organisational modifications and adjustments to systems, processes and procedures. These changes influence organisational arrangements and operations. Learning is the process through which organisations are able to cope with the discontinuities and disruptions that are encountered as a result of alterations and modifications experienced through socio-technical interactions during the process of TT. It emerges out of necessity for the organizations involved to adjust to expected changes as a result of transferring and/or receiving new technology (cf. Manimala and Thomas 2013). The process of learning in TT is influenced by: the nature and composition of the technology (higher complexity demands stronger learning interactions); the process of technology transfer; the vehicle of transfer; the objectives and motives of the parties; the learning environment within and between the parties; and the learning capabilities of the actors (Gorman 2002; Wahab *et al*., 2012b). Within the series of interactions, alterations and modifications, processes that can be considered to reflect learning (see Huber 1991; Schilling and Kluge 2009; Manimala and Thomas 2013) on the part of the actors can be traced through an analysis of the TT process using the social construction of technology (SCOT) theoretical constructs of 'interpretative flexibility', and 'closure and stabilisation'.

The Social Construction of Technology

The social construction of technology (SCOT) was first put forward by Pinch and Bijker (1984). SCOT presents “a coherent and inclusive approach for interrogating the complex realities of interactions between people, technology and institutions in empirical settings” (Schweber and Harty 2010: 673). The theoretical framework describes the development, uptake and adoption of technology within a context as a continuous process of evolution, and a continuous cycle of alternation of variations and selection (Pinch and Bijker 1984).

SCOT is based on a set of assumptions. First, technology is socially constructed, and does not comprise of only artefacts, products or machinery. It is developed through a system of interactions between human and non-human elements within a social context to achieve an intended outcome. It comprises physical artefacts, organisations, knowledge, and legislative frameworks. Second, a technological system is developed through interactions between the components of a social context being: the technology, the environment, the organisation(s) and the human actors. Finally, technology, its transfer, social context, and the actors are not considered as different components of a technological system governed by different rules. They are all considered as a single unit, operating and influencing each other through series of interactions and negotiations towards a desired outcome (Pinch and Bijker 1984).

Core constructs

SCOT is made up of four major constructs: Relevant Social Groups (RSGs), Interpretative Flexibility, Stabilization or Closure and, the Wider Context. Relevant social groups (RSGs) refer to the parties who influence the nature of a technology, i.e. an individual, organisation or, group(s) of individuals; whether organised or not. In influencing technology, they also concurrently undergo alterations. The relevance of

a group is primarily linked to the extent to which the technology involved is important to them. Direct and indirect RSGs vary per the technology and the context. For every technology, the RSGs may have a set of shared and/or conflicting meanings, forming different 'technological frames'. A technological frame is the sum of understandings of all the RSGs for a particular technology; comprising goals, problems, guiding principles, operation procedures, and artefacts (see Elle *et al*., 2010). Differences in technological frames lead to conflicting views among RSGs. This creates strata between groups with different technological frames on the explicit and/or tacit aspects of a technology. The differences in technological frames between RSGs reflect the complexity of technology, hence depicting its 'interpretative flexibility'. The conflict between technological frames is because technology can be designed in several ways, and is thus likely to be understood from different perspectives by RSGs. Additionally, the development of technology encounters conflicting opinions among RSGs, because they do not share the same, or similar expectations of the functions of technology owing to their different backgrounds (Pinch and Bijker 1984).

In achieving closure and stabilisation, steps are taken by the RSGs to merge the different perspectives by way of exchange of explicit information and tacit experiences. This allows the RSGs to relate to the technology from a common set of technological frames. When this has been achieved, there will not be any need for further modifications of that technology among the actors in a given context. However, attaining this level is not absolute. Technology is considered to have reached a level of closure and stabilisation according to the RSGs involved. All the socio-technical interactions in the development and transfer of technology do not take place in a vacuum; the wider context is the environment within which technological development and transfer takes place (Pinch and Bijker 1984). This may be an organisational or inter-organisational, industrial or sectorial, national or international setting within which all the interactions take place.

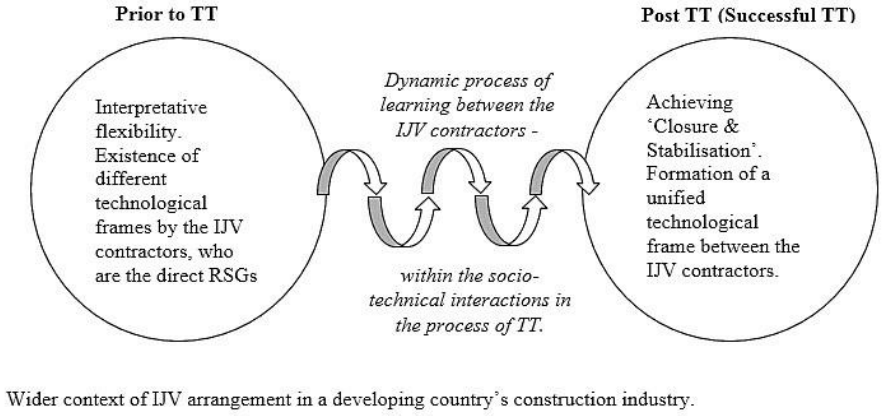
Technology Transfer through a 'Scot' Lens

The relevant social groups (RSGs) are made up of individuals from the local and foreign IJV contractors involved in construction TT. Prior to the transfer of technology, the interpretative flexibility of the technology is revealed in the conflicting understandings among the actors involved. The understanding of the contractors about what the technology stands for, how it can be used on a construction project, and its potential effect on their internal and external operations vary. The conflicting perspectives become pronounced in the face of contextual differences between developed and developing countries, as the actors have different levels of exposure to prevailing technology. Towards a successful TT, the IJV contractors need to resolve the conflicts in understandings surrounding the technology at hand; and by this achieve some closure and stabilisation. This is by means of series of interactions, leading to alterations and modifications in the actors and the technology. The processes of change and adjustments are made possible through learning processes that are developed and utilized during the process of TT, illustrated in figure 1.

The process of transferring and/or receiving technology through socio-technical interactions by TT parties is inseparable from the processes of alterations in technological frames. During TT, the technology undergoes phases of alternation and variation (see Pinch and Bijker 1984) as part of being received by the transferee. Concurrently, the RSGs also undergo some changes during the socio-technical interactions with the technology. These modifications in the actors and the

technology lead to changes in technological frames, as well as the development of a 'stabilized' iteration of that technology respectively, as part of the TT.

Figure 1: From 'interpretative flexibility' to 'closure and stabilisation' through learning



All of these contribute to achieving some level of 'closure and stabilisation', partial or absolute, for the technology (see Skjølsvold and Ryghaug 2015). The actors involved would have eliminated their conflicting understandings to an extent, and TT would have been achieved (see figure 1 above). Overall, the inter-organisational IJV arrangement and the construction industry play the role of the wider context for the socio-technical interactions, as well as contribute to the social shaping of technology as illustrated in figure 1 above.

In order to explain the process of TT as series of socio-technical interactions between IJV contractors on a construction project through SCOT, we argue that, it is imperative to identify: Who make up the RSGs involved in the development and transfer of technology? Which aspects of the technology are considered important by the parties? How do the RSGs ascribe different meanings to the technology in question? What purpose is the technology in question addressing from the perspectives of the RSGs? What processes do the RSGs go through in order to adjust to the alterations and modifications as a result of receiving technology? How are the RSGs able to negotiate series of meanings throughout TT, as part of achieving some closure and stabilisation for the technology, in order to achieve satisfactory transfer of technology?

Exploring these questions will help explain how the parties involved in TT negotiate meanings, and adjust to modifications amidst series of interactions. The answers will also shed light on how technology is altered to suit the interests of the actors during TT. All of these will contribute to providing a more comprehensive explanation for TT on a construction project, given the multiple actors involved from diverse backgrounds. This contrasts traditional views where technology is usually fixed, and TT is a linear arrangement.

Concluding Remarks

Technology transfer has been studied from compartmentalised perspectives over the years, neglecting the socio-technical interactions that take place. This has failed to capture the co-development of technology and the actors involved, alongside the multiple interactions. In this paper, we have, therefore, put forward an alternative view of TT. We have argued that technology and its transfer should be viewed as a

process of socio-technical interactions between actors, the technology and the context. This allows for the complexities in the process of TT to be explored, putting the socio-technical interactions into perspective. As part of the socio-technical interactions in TT, learning has been presented as one of the key processes which plays a vital role towards a successful transfer of technology. We have also demonstrated that the theoretical framework of SCOT can be used to explain the interactions between actors, technology and organisations in TT under IJV an arrangement. Within these interactions, we have explained that the processes of learning in TT can be identified, using the SCOT constructs of 'interpretative flexibility' and, 'closure and stabilisation'.

We put across an argument for a rethink about the approach to studying TT in construction. This will open up the complexities entailed in the process, and put the socio-technical interactions involved in perspective. Additionally, it will help provide additional explanation of TT between contractor IJVs in developing countries. Relatedly, this may offer useful insight to developing countries who are attempting to improve their local construction industries through TT.

REFERENCES

Abbott, C, Jones, V L, Sexton, M G and Lu, S L (2007) *Action Learning As An Enabler For Successful Technology Transfer With Construction SMEs*. RICS research paper series, **7**(16), 1-41.

Ayittey, G B N (2002) *The Failure of World Bank Policies in Africa*. Washington DC: The Economic Affairs Subcommittee of the Senate Foreign Relations Committee.

Boyd, P, Larsen, G D and Schweber, L (2015) The co-development of technology and new buildings: Incorporating building integrated photovoltaics. *Construction Management and Economics*, **33**(5-6), 349-360.

Chrysostome, E, Nigam, R and Jarilowski, C S (2013) Revisiting strategic learning in international joint ventures: A knowledge creation perspective. *International Journal of Management*, **30**(1), 88-98.

Devapriya, K and Ganesan, S (2002) Technology transfer through subcontracting in developing countries. *Building Research and Information*, **30**(3), 171-82.

Elle, M, Dammann, S, Lentsch, J and Hansen, K (2010). Learning from the social construction of environmental indicators: From the retrospective to the pro-active use of SCOT in technology development. *Building and Environment*, **45**(1), 135-142.

Estache, A (2005) *What Do We Know about Sub-Saharan Africa's Infrastructure and the Impact of Its 1990s Reforms?* Washington DC: World Bank.

Gorman, M E (2002) Types of knowledge and their roles in technology transfer. *The Journal of Technology Transfer*, **27**(3), 219-231.

Harty, C (2005) Innovation in construction: a sociology of technology approach. *Building Research & Information*, **33**(6), 512-522.

Haug, D M (1991) International Transfer of Technology: Lessons that east Europe can learn from the failed Third World experience. *Harvard Journal of Law & Technology*, **5**, 209-240.

Heidegger, M (1977) *The Question Concerning Technology, And Other Essays*. New York: Harper & Row.

Huber, G P (1991) Organizational learning: The contributing processes and the literatures. *Organization Science*, **2**(1), 88-115.

Ismail, F, Ruikar, K D, Carrillo, P and Anumba, C J (2009) Technology transfer in construction: Learning from the manufacturing industry. *In*: A Dainty (Ed.) *Proceedings 25th Annual ARCOM Conference*, 7-9 September 2009, Nottingham, UK. Association of Researchers in Construction Management, Vol. 2, 739-748.

Manimala, M J, and Thomas, K R (2013) Learning Needs of Technology Transfer: Coping with Discontinuities and Disruptions. *Journal of the Knowledge Economy*, **4**(4), 511-539.

Ofori, G (1994) Construction industry development: role of technology transfer. *Construction Management and Economics*, **12**(5), 379-92.

Osabutey, E L, Williams, K and Debrah, Y A (2014) The potential for technology and knowledge transfers between foreign and local firms: A study of the construction industry in Ghana. *Journal of World Business*, **49**(4), 560-571.

Pinch, T J and Bijker, W E (1984) The social construction of facts and artefacts: Or how the sociology of science and the sociology of technology might benefit each other. *Social Studies of Science*, **14**(3), 399-441.

Rwelamila P D, Henjewele C and Mkandawire S (2013) Capacity building in emerging economies through international construction ventures: Case study of the NMPP project. *In*: S D Smith and D D Ahiaga-Dagbui (Eds.) *Proceedings 29th Annual ARCOM Conference*, 2-4 September 2013, Reading, UK. Association of Researchers in Construction Management, 483-492.

Sackey, E, Tuuli, M and Dainty, A (2014) Sociotechnical systems approach to BIM implementation in a multidisciplinary construction context. *Journal of Management in Engineering*, **31**(1), 1–11.

Schilling, J and Kluge, A (2009) Barriers to organizational learning: An integration of theory and research. *International Journal of Management Reviews*, **11**(3), 337-60.

Schweber, L and Harty, C (2010) Actors and objects: A socio-technical networks approach to technology uptake in the construction sector. *Construction Management and Economics*, **28**(6), 657-674.

Skjølsvold, T M and Ryghaug, M (2015) Embedding smart energy technology in built environments: A comparative study of four smart grid demonstration projects. *Indoor and Built Environment*, **24**(7), 878-890.

United Nations Conference on Trade and Development (2014) *Transfer of Technology and Knowledge Sharing for Development: Science, Technology and Innovation issues in developing countries. No.8*. Geneva: United Nations.

Wahab, S A, Rose, R C and Osman, S I W (2012a) Defining the concepts of technology and technology transfer: A literature analysis. *International Business Research*, **5**(1), 61-71.

Wahab, S A, Rose, R C and Osman, S I W (2012b) The theoretical perspectives underlying technology transfer: A literature review. *International Journal of Business and Management*, **7**(2), 277-288.

Williams, R and Edge, D (1996) The social shaping of technology. *Research Policy*, **25**(6), 865-899.

EXPANSIVE LEARNING IN CONSTRUCTION PROJECTS - A CONTRADICTION IN TERMS?

Anne Klitgaard[1], Frederikke Beck, Henrik Buhl, René Dahl Jeppesen and Soeren Bülow Nissen

[1] *Department of Construction, University College Northern Denmark, Sofiendalsvej 60, 9200 Aalborg SV, Denmark*

This research is a preliminary study performed as part of a primary research into expansive learning in interorganizational network set up to solve a construction project. The construction industry has long had issues about productivity, which can be an indication of lack of learning. A case study of a workshop was conducted where coordination and collaboration meetings were observed. The data was analysed using activity theory and the expansive learning model. The analysis shows that the strong focus on object by project's activity system hinders expansive learning. The students learned through acquisition and participation but not by expansive learning. The construction industry needs to accept that the learning generated from projects will be limited to learning by acquisition and participation. The interorganizational network cannot facilitate expansive learning while working on object-fixed projects. Research in construction management fails to generate and document knowledge because of the limitations of case studies.

Keywords: activity theory, construction management, interorganizational network, learning

INTRODUCTION

The productivity in the Danish Building industry compared to the consumer cost index has fallen over the last 50 years even after correction for increased standard of the projects (Nielsen, Pedersen and Haugbølle 2010). A similar situation exists in the UK construction industry where Addis (2014, 1245) finds: "*Performance […] has long been regarded as unsatisfactory [and] despite a number of reviews and policy initiatives to produce productivity, quality and competitiveness gains the industry has failed to meet improvement targets in a range of areas."* We set out to investigate if the industry is learning, as the low productivity can be a result of low level of learning within the industry.

Construction projects viewed from an organizational perspective "*are multi-actor projects in which a broad range of actors are involved with different competences and specialties are involved*" Eriksson (2013, 336). It can be considered an interorganizational network. It is difficult to find a universal accepted definition for the term interorganizational network (ION). Najafian and Colabi (2014, 58) found in their survey: *"inter-organizational networks relationships is often studied without an explicit definition of the construct."* In their review of 24 articles, they found that 26%

[1] ankw@ucn.dk

Klitgaard, A, Beck, F, Buhl, H, Jeppesen, R D and Nissen, S B (2016) Expansive Learning in Construction Projects - A Contradiction in Terms?. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 709-717.

percent of the articles did not include a definition, 56 % included a conceptualization while 17% had an explicit definition.

Two main conceptualization of an ION are in Bergenholtz and Waldstrøm's (2011, 540) review defined as "[1] *the network is considered a metaphor for some kind of interaction across an organizational boundary, or [2] the term refers to the specific social structure between organizations."* The analytical perspective relies on the *"fundamental proposition that an organization's structural position in a network influences its opportunities and constraints"* (Bergenholtz and Waldstrøm 2011, 541).

This research adopts the analytical perspective to the ION. We accept an organization's position in the network influences its' *opportunities and constraints'* for learning.

Construction projects can also be viewed "*as the creation of new value in society*", states Winch (2010, 5), where the "*inputs into the process are capital and human resources - capital to cover the costs of investment; human resources to transform ideas into reality. […] The return on human resources is the learning that takes place."*

The two metaphors of knowledge, introduced by Anne Sfard helps understanding what knowledge is and how learning happens. The acquisition metaphor illustrates the mind, as *"a kind of container of knowledge and learning is a process that fills the container."* Secondly, the participation metaphor views *"learning as a process of participation in various cultural practices and shared learning activities […] Knowledge does not exist in a world of its own or in individual minds but as an aspect of participation in cultural practices* (Paavola, Lipponen and Hakkarainen 2004, 557).

However, Paavola, Lipponen and Hakkarainen (2004, 558) maintain: *"There is room - and a need - for a third metaphor of learning".* They call this metaphor for 'the knowledge-creation-metaphor'. They find *"The knowledge-creation perspective focuses on analyzing the processes whereby new knowledge and new mediating objects of activity are collaboratively created, whether in schools or at world."* Paavola, Lipponen, & Hakkarainen (2004, 573).

Three models can be used to understand the knowledge-creation metaphor, suggests Paavola, Lipponen, & Hakkarainen (2004). They are: Nonaka and Takeuchi's model of learning-creation, Engeström's model of expansive learning and Bereiter's model of knowledge building. We chose to use Engeström's expansive learning as it has a very clear focus on interorganizational learning.

This research investigates expansive learning in construction projects. We ask the question: how does the interorganizational network create knowledge from expansive learning during a construction project?

Theoretical Framework: Activity Theory, Expansive Learning and Contradictions

The research data is analyzed using activity theory. It allows for investigation into "*what is done and learned together instead of studying only connections and collaboration of work"* (Engeström and Kerosuo 2007, 336). The unit of analysis in this research is the collective activity system. The subjects (the participants) will use mediating artefacts to reach their object while under influence from the collective set of rules, communities as well as the established division of labor. The outcome is the result of the activity, figure 1 (Engeström and Sannino 2010).

We focus on the collective activity system following Martin's (2011, 543) recommendation: "The application of the activity theory is only possible if the entirety of interacting parties (e.g. subcontractor and contractor is seen as one system".

An understanding of the decisions and the following actions by the collective activity system requires an understanding of its object. The object "shapes and directs the activity and determines the horizon of possible actions" (Foot 2009, 3). The object "represent and explain the collective motive of the activity" although "it is not fixed but constantly changing, constructed and re-constructed" (Toiviainen 2007, 348).

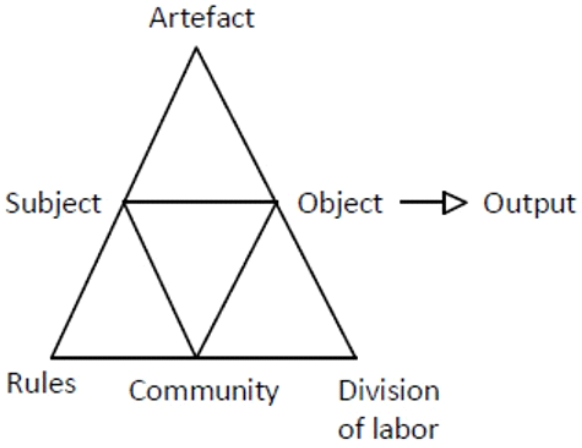


Figure 1: The collective activity system

We set out to find examples of expansive learning, which happens when: "*Learners learn something that is not there yet"* (Engeström and Sannino, 2010, 2). Expansive learning, the creation of new knowledge, can be depicted in an ideal-typical sequence in the expansive cycle, figure 2.

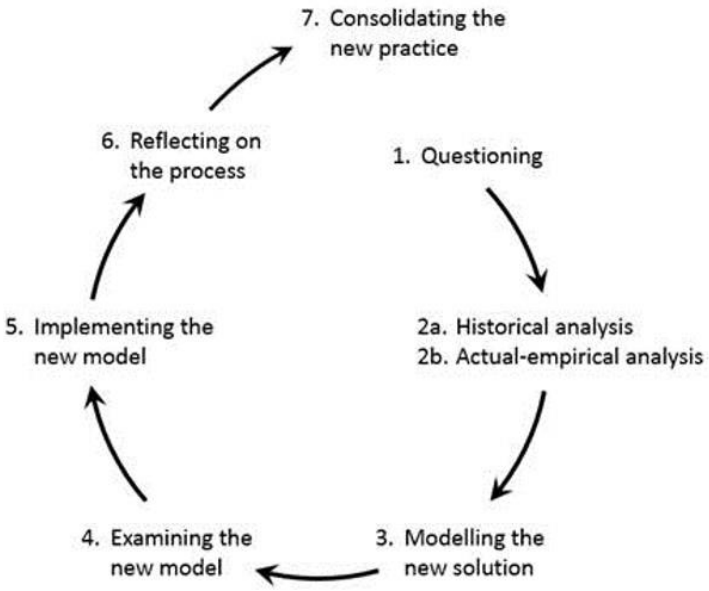


Figure 2: The expansive cycle of learning actions (Engeström 2000, 970)

Expansive learning can happen in many contexts. In their review on the subject Engeström and Sannino (2010) find expansive learning can happen as: the transformation of the object, movement in the zone of proximal development, cycles

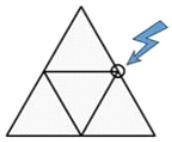
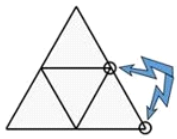
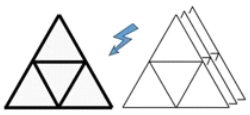
of learning actions, boundary crossing and network building, distributed and discontinuous movement and as a result of formative intervention.

In this research, we investigated, whether expansive learning as transformation of objects happens. An expansive learning event is object-oriented, so by following the object, it becomes *"possible to identify and analytically discern one [learning] event from another* (Toiviainen 2007, 348). Engeström and Sannino (2010, 2) uses object-changes to understand learning by expansion: *"The learners construct a new object and concept for their collective activity and implement this new object and concept in practice".* Learning is not *"manifested as changes in the subject*" but as "*changes in the object of the collective activity*" (Engeström and Sannino 2010, 8).

The first stage in the expansive learning cycle (fig. 2) is, where the activity system is *"questioning, criticizing or rejecting some aspects of the accepted practice and existing wisdom"* (Engeström and Sannino 2010, 7). This questioning can happen when a contradiction occurs. In this way, a contradiction becomes the *"actual driving force of expansive learning when they are dealt with in such a way that an emerging new object is identified and turned into motive".* (Engeström and Sannino 2010, 7).

Contradictions happen in different phases of the learning process. A description and visualization of the contradictions can be found in table 1. Identification of contradictions allows for evaluation of the activity system's reaction to expansive learning opportunity.

Table 1. Description and visualization of contradictions based on (Engeström and Sannino 210, 7)

Type	Description	Visualization
Primary	Contradiction within the nodes of the collective present activity system, typically the object's use value versus exchange value.	
Secondary	Contradiction between nodes in the collective present activity system.	
Tertiary	Contradictions between the present dominant activity system and one (or more) of the member's more cultural advanced activity system.	
Quaternary	Contradictions when changes in one of the member's activity system affects the present collective activity system.	

The expansive learning cycle can be applied to any activity system, but it is important to *"distinguish between short-lived goal-directed actions and durable, object-oriented activity systems"* (Engeström 2000, 961).

In this way we apply activity theory to an "analysis of knowledge creation processes" as suggested by Martin and Hartmann (745), who found *" activity theory seems to be appropriate to describe micro level processes, in which individuals act and respond to situations based on given historical development, but also changing their frame of reference."* They found this useful as it offers an opportunity for "*analysis of micro level processes, linking these back to macro level circumstances."*

Expansive learning in a collective activity system is problematic in three ways as pointed out by Young (2001). First, is the problem of knowledge: how does the activity system access knowledge, which is not available in the system and will new knowledge be allowed to emerge if it challenges the position of some of the members? The second problem relates to power: is the willingness to enter into the questioning phase hindered by fear of being viewed as a troublemaker? The third problem is motivation: will all members be motivated to generate new knowledge? These problems are very relevant when the ION is viewed from the analytical perspective.

This theoretical framework allows us to observe for contradictions as they indicate an expansive learning opportunity. The response of the activity system to the contradiction will clarify how the activity system is creating knowledge through expansive learning. In the next chapter, the observed project will be described and the findings will be described and discussed.

METHODOLOGY

The research design is a small-scale case study. It should provide useful insight before making the choice of research strategy for the larger research project into learning in interorganizational network.

The research is based on a case-oriented research strategy. The case study is chosen "*to contribute to our knowledge of individual, group, organizational, social, political, and related phenomena.*" (Yin 2009, 4) The use of case studies for the collection of data can be controversial. But Yin (2009) and Flyvbjerg (2006) argues that case studies can be used for collecting valid data. The data must be presented in a rigorous and objective way (Yin 2009).

The data was collected during "The digital days", which is a yearly event at a University College in Denmark. The event offers an opportunity for students to work with new technology as well as practice their collaboration skills. Students with different educational background are teamed together to act as different professions in the industry. This year they must design a refurbishment project of a school and compete to win a fictive tender. The students have the option to participate in lectures about the industry's move towards increased use of building information modelling. Eighteen students from five different educations as well as two secondary school pupils (to act as users of the final project) were observed. Mentors from the industry were available to assist the students. Nine meetings were observed and recorded (125 minutes in total). All the participants were not present at all meetings. Semi-structured interviews were conducted with two of the participants and one of their external mentors before and after the meetings.

The videotapes and the recorded dialogue were studied for signs of contradictions in the activity system consisting of the participating students.

FINDINGS AND ANALYSIS

Observations of primary and secondary contradictions in the activity system will be presented here. An example of a tertiary contradiction was also identified but is not presented here. We identified them by observation during the project meetings as well as video footage from the meetings. These terms will be used in the following; Project manager - PM, Mechanical engineering plumber - MEP, Architect - ARC and Engineer - ENG.

Examples of Primary Contradictions

The first contradiction was identified at the first project meeting, where the participants were introduced to each other for the first time. At this meeting, the students discussed their role in the project.

The project manager addressed the fulfilment of the award criteria as the goal (shared object), several times. As a response to this, one of the participants placed the question giving the first contradiction. "*Should we coordinate something in relation to the lectures?*" The PM replies:

> 1. Yes, yes that is right. There are held some lectures during the day […] Of course, it is annoying if all architects just stat to slip away, so that we cannot really move forward. [….] so if people are interested to participate in the meetings, then I think they should just do it. I mean - we are also here to learn.

The contradiction lies in the shared object - the conflict between the opportunity to change the object from being the fulfillment of the project to the learning made available through the lectures. It is a primary contradiction. The learning opportunity is addressed, but it is ignored and the fulfillment of the project continues to be the object.

At day two, the project group was unexpectedly informed that they were allowed to move columns in the existing structure. The ARC response was:

> 2.It could be cool to remove a column, then we could make the rooms a little bigger […] it will affect everybody. We will probably be set back if we remove a column now.

The PM chooses to ignore the option for "cool" design as it threatens the need for progress. It is an example of primary contradiction between the use value (cool design) and the exchange value (project fulfillment within the time frame). The opportunity for object changes and expansive learning is missed.

Example of Secondary Contradictions

During the first two days, a secondary contradiction evolved. Due to the fact, that the project needs to be designed, the work pressure was high on the ARCs. The MEP indicates several times, that the dimensions and the placements of the windows are important for them so they can make their calculations in order to avoid delay to the progress later.

On day one, the ARC argue that the MEP should suggest the dimensions of the windows as well as the placement. This suggestion means a small alteration to the activity system's division of labor. The ARC says:

> 3.I imagine we make a description, of where we want the windows, how large they should be, then you [addressing the MEP role] can make a suggestion which is a little more accurate […] And then we can go in and get them placed at the end. Because otherwise, I think we are going to spend too much time before we can release it to you, and then you get started too late, I think…

As the pressure for progress escalates on day two, the ARC becomes more willing to change the activity system;

> 4.[…] Yesterday we talked about that you are welcome to look in to what windows we could use - in other words to come up with suggestions for it - sizes and so on.

The change in the division of labor evolves when the MEP suggest taking over even more of that work;

> 5.We might as well place the windows and that if you would like to outsource it?

The discussion in the project group continues with the focus on the division of labor. The responsibility to find the dimensions and the placements of the windows changes from being the full responsibility of the ARC to be divided between the MEPs, the ENGs and the ARCs.

The contradiction identified is between being able to deliver the project on time (object) and the impossibility for the architect to generate the progress due to lack of man-hours. The contradiction is a secondary contradiction - between the object and the present collective activity system. They change the division of labor within the activity system to eliminate the secondary contradiction.

CONCLUDING REMARKS

It seems almost impossible for an interorganizational network surrounding a construction project to learn expansively. There are two main obstacles.

First, the goal-directedness obstructs for reacting on expansive learning opportunities. The network created to solve a construction project are performing "*short-lived goal-directed actions and* [it does not form] *durable, object-oriented activity systems"* (Engeström 2000, 961).

Second, the organizations in the project do have a "*structural position in a network [which] influences its opportunities and constraints"* (Bergenholtz and Waldstrøm 2011, 541). This means that all Young's (2001) concerns of knowledge, power and motivation in expansive learning become very relevant.

Historically, we have seen different attempt to reduce the tension and contradictions in the activity system. An example is partnering, where "*the potential of partnering as a change strategy critically depends on the ability to handle the situated tensions and contradictions that occur within and between activity systems, when existing practices and activities are destabilized and the rationalities of existing systems are called into questions."* (Gottlieb and Haugbølle 2013, 132). We question if contradictions should be 'handled' or should they be accepted, as the learning opportunities, they represent.

The construction industry is moving from one project to the next forcing changes to object and activity system (partnering, the use of ICT, new tendering criteria) in an attempt to 'handle' tensions and contradictions. Handling of the tensions may ensure a smooth path towards delivering the project, but also hinders expansive learning.

Although we agreed with Martin and Hartmann's (2010) idea of using activity system to understand the actions and re-actions in the activity system, we question the value of the learning from such analysis, as the likelihood to discover expansive learning is limited.

The construction industry needs to accept that the learning stemming from projects will be limited to learning by acquisition and participation. As a result, construction management researchers need to acknowledge that the study of cases of construction

projects will not generate the opportunity to document the creation of new knowledge - expansive learning.

Our first research results have revealed some interesting findings about construction projects and expansive learning. In our further research, we shall look into new ways of experimenting and facilitate interorganizational networks in order to create new knowledge. In summary, we ask ourselves: "Expansive learning in construction projects - a contradiction in terms?"

REFERENCES

Addis, M (2014) Tacit and explicit knowledge in construction management. *In*: A Raiden and E Aboagye-Nimo (Eds.) *Proceedings 30th Annual ARCOM Conference*, 1-3 September 2014, Portsmouth, UK. Association of Researchers in Construction Management, 1245-52.

Bergenholtz, C and Waldstrøm, C (2011) Inter-organizational network studies: A literature review. *Industry and Innovation*, **18**(6), 537-562.

Engeström, Y and Kerosuo, H (2007) From workplace learning to interorganizational learning and back: The contribution of activity theory. *Journal of Workplace Learning*, **19**(6), 336-42.

Engeström, Y and Sannino, A (2010) Studies of expansive learning: Foundations, findings and future challenges. *Educational Research Review*, **5**(1), 1-24.

Eriksson, P E (2013) Exploration and exploitation in project-based organizations: Development and diffusion of knowledge at different organizational levels in construction companies. *International Journal of Project Management*, **31**, 333-341.

Gottlieb, S C and Haugbølle, K (2013) Contradictions and collaboration: Partnering in-between systems of production, values and interests. *Construction Management and Economics*, **31**(2), 119-134.

Foot, K (2009) Pursuing an evolving object: A case study in object formation and identification. *Mind, Culture and Activity*, **9**(2), 132-149.

Flyvbjerg, B (2006). Five misunderstandings about case-study research. *Qualitative Inquiry*, **12**(2), 219-245.

Martin, L (2011) Learning in the construction industry: An analysis based on the activity system *In*: C Egbu and E C W Lou (Eds.) *Proceedings 27th Annual ARCOM Conference*, 5-7 September 2011, Bristol, UK. Association of Researchers in Construction Management, 535-44.

Martin, L and Hartmann, A (2010) Understanding knowledge creation in construction: activity theory as an alternative approach. *In*: C Egbu (Ed.) *Proceedings 26th Annual ARCOM Conference*, 6-8 September 2010, Leeds, UK. Association of Researchers in Construction Management, Vol. 1, 737-46.

Najafian, M and Colabi, A M (2014) Inter-organizational relationship and innovation: A review of literature. *Global Business and Management Research: An international Journal*, **6**(1), 52-70.

Nielsen J, Pedersen E S and Haugbølle K (2010) *Byggeriets Produktivitet - udvikling i boligbyggeriets standard Dokumentationsrapport 2*. Statens Byggeforskningsinstitut.

Paavola, S, Lipponen, L and Hakkarainen (2004) Models of innovative knowledge communities and three metaphors of learning. *Review of Educational Research*, **74**(4), 557-576.

Toiviainen, H (2007) Inter-organizational learning across: An object-oriented approach. *Journal of Workplace Learning*, **19**(6), 343-358.

Winch, G M (2010) *Managing Construction Projects*. Oxford: Blackwell Science.

Young, M (2001) Contextualizing a new approach to learning. *Journal of Education and Work*, **14**(1), 157-161.

Yin, R K (2009) *Case Study Research: Design and Methods*. London: Sage publications.

TESTING A PROPOSITION FOR A KNOWLEDGE MANAGEMENT METHOD FOR REFURBISHMENT

Mary Lundberg[1] and Helena Lidelöw

[1] *Luleå University of Technology, SE-971 87, Luleå, Sweden*

The ongoing research reported here is testing a proposition for a knowledge management method for managing knowledge during and between refurbishment projects. Data has been collected by a researcher acting as an observer at meetings associated with five refurbishment projects, two in Denmark and three in Sweden, where knowledge and experiences gained were discussed. The observations were structured into three themes; planning, logistics and handling of tenants, coded and then analysed against the proposition. The results confirm the importance of awareness that the construction industry is several communities of practices and that the project teams' network and relationships, i.e. the organizational context, provide foundations for learning when developing strategies to manage knowledge in the industry, both in new builds and refurbishment programmes. Additionally, many of the practices on construction sites are based on tacit knowledge that is deeply rooted within individuals. Thus, harnessing such knowledge, by involving individuals in learning through communication and discussion having a knowing in practice perspective and including a coordinating function within a platform are key elements of a knowledge management method.

Keywords: experience, platform, million homes programme, tenants, learning

INTRODUCTION

In many of Europe´s big cities, uniform apartment blocks were built in large-scale areas during the 1960s and 1970s in programmes, including the Million Homes Programme in Sweden, intended to improve the housing stock. Now, some 40 years later, many of those buildings have deteriorated and are of low quality (Hall and Vidén 2005). Despite large variations in the building technology used during the Million Homes Programme (Formas, 2012), many of the housing complexes consist of numerous similar apartments that will be refurbished in the same manner, which enables systemic use of repetitive elements and a more effective refurbishment. In such cases, a method for managing relevant knowledge to increase learning within and between different refurbishment projects by incorporating mechanisms to reuse information and integrate experiences, i.e. experience feedback, is highly useful and reduces the risk for wasting a great deal of time and effort in the projects.

A major Swedish contractor has identified refurbishment as an emerging market and decided to collect experiences from the execution of refurbishment projects within their organization. Each project is different in terms of building technology and scope, so the contractor will obtain no direct technology-related benefit from systematizing experiences. However, the firm believes that benefits can be obtained by systematizing experiences regarding processes including planning, logistics and

[1] mary.lundberg@ltu.se

Lundberg, M and Lidelöw, H (2016) Testing a Proposition for a Knowledge Management Method for Refurbishment. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 719-728.

handling of tenants. One means of systemizing experiences is to use a platform concept which in this paper is regarded as a knowledge management method with the purpose to increase learning within and between different refurbishment projects. The theoretical foundations underlying this assumption are scrutinized and a proposition is put forward based on theory about platforms, knowledge, knowledge management, and organizational learning. These theories are then viewed in the context of the construction industry.

CONCEPTUAL FRAMEWORK

Platform

Various authors have addressed the management of knowledge in new-build projects in companies using a platform concept (Dave and Koskela, 2009, Meiling, 2010, Styhre and Gluch, 2010, Thuesen and Hvam, 2011, Jansson et al., 2014, and Lessing et al., 2015). These authors have highlighted, inter alia, the importance of integrating experiences gained from earlier projects into such platforms, which can be regarded as vehicles for conveying information between projects (Jansson et al., 2014). The management of knowledge during and between refurbishment projects, the focus of this study, has received little research attention. According to Robertson and Ulrich (1998), a platform is the collection of assets that are shared by a set of products. These assets are components, processes, knowledge, and relationships. In slight contrast, platforms for the refurbishment of buildings would largely consist of processes, knowledge, and relationships. Platform organization was developed in industries where competitiveness depends on offering several defined variants to the customer (Meyer and Utterback 1992). Building new variants from scratch is costly, so companies started identifying, improving and standardizing commonalities, i.e. parts that were common to all variants (ibid.). In a platform for house refurbishment the corresponding commonalities are processes that will always be present in a project.

Knowledge and knowing in practice

As noted by Alvesson and Kärreman (2001), “There are many, highly diverse understandings of knowledge” (ibid. 997). Nonaka and Takeuchi (1995) argue that knowledge takes various forms. One form they recognise is explicit knowledge, which can be expressed in words and numbers and thus can be transmitted between individuals formally and systematically. Hislop (2009) refers to such knowledge as “know-what”. A contrasting form recognized by Nonaka and Takeuchi (1995) is tacit knowledge, which is highly personal and deeply rooted in individual´s actions, experiences, ideas, values and emotions. Hence, tacit knowledge is often difficult to verbalize and communicate to others, and Hislop (2009) refers to such knowledge as “know-how”. Nonaka and Takeuchi (1995) further hold that interaction between tacit and explicit knowledge is vital for the creation of new knowledge, that tacit knowledge can be converted to explicit knowledge, and explicit knowledge can be absorbed by individuals and converted to tacit knowledge.

Polanyi (1983) argues that explicit and tacit knowledge are different dimensions of the same knowledge and they are complementary, a view supported by Tsoukas (2003). According to Jonsson (2012), tacit knowledge is sometimes regarded as knowing and argues that knowledge is a process; the use of knowledge is expressed as an individual’s ability to mobilize it in action. Similarly, Lam (2000) holds that large parts of human knowledge are tacit, particularly operational skills and know-how

acquired through practical experience. Thus, as large proportions of the work carried out on a construction site is inherently action-oriented, practical experience-based and performed according to rules of thumb, much of it is arguably rooted in tacit knowledge. This may be a complicating factor for the construction of a platform for refurbishment, particularly according to the knowing in practice perspective, which holds that not all knowledge can be objectified, and "focuses on experiences and knowing how to do something, or how to perform a task, rather than on how to store and transform information and knowledge" (Jonsson, 2015, 49).

Knowledge and its management

Knowledge management has been addressed and advocated by both practitioners and scholars in a broad range of disciplines (Alvesson, 2004). "Knowledge management can be seen as an umbrella term for a wide spectrum of academic orientations. These include information systems and organizational learning but also strategic management and innovation" (Alvesson and Kärreman, 2001, 996). Since the 1990s, when the knowledge-based view of the firm emerged, many organizations have invested in various solutions for managing knowledge, but there are not many success stories (Huysman and Wulf, 2005). Jonsson (2015) argues that most organizations seem to be obsessed with solutions intended simply to improve the accessibility of information by using information technology. However, a key step towards effective knowledge management and ultimately experience feedback is to understand how knowledge is shared in practice, in the day- to-day work (ibid.). Javernick-Will (2012) adds to the critique by stating that knowledge management scholars have mostly focused on macro-level constructs and relationships, i.e. at the organizational level. Thus, they have recognized the importance of technology, communication strategies and resources for sharing knowledge. Nevertheless, processes of locating, providing and reusing knowledge within an organization largely occur on the micro, individual employee, level. Cyert and March (1963), who were among the first to connect research on economics and organizations, argue that an organization can be viewed as a coalition of individuals with their own histories and goals. Therefore in knowledge management, it is crucial to involve the individuals who will provide and use the knowledge.

Two main approaches to knowledge management can be discerned: one focus on technical elements and the other on human factors, i.e. social processes. Some authors treat knowledge as a resource that can be managed like any other (tangible) resource, while others focus on managing knowledge work rather than knowledge itself Newell (2015). However, according to Easterby-Smith and Lyles (2011, p.106), "Effective knowledge management in organizations involves a combination of technological and social elements".

Organizational learning and learning organizations

As argued by Cyert and March (1963) organizations learn through the same processes as individual human beings and exhibit adaptive behaviour over time. Organizations could be seen as consisting of collections of individuals involved in continuous bargaining processes trying to reach decisions regarding their respective organizations´ pressing problems (ibid.). Argyris (1995) suggests that the individual is the key to organizational learning because it is individuals´ thinking and acting that result in learning. Further, actions that individuals have found to be useful and are accepted by the rest of the organization are key elements of organizational learning, thus there is a high degree of casual interdependency between the individual and the

organization (ibid.). An organization is viewed as a learning organization insofar the organizational context contributes to increased learning and knowledge sharing Jonsson (2015).

Senge (1997) supports Cyert and March (1963) and Argyris (1995) arguing that "human perception conforms to `mental models´ that govern the way we think the world works…they shape the way people, and therefore organizations, act." Senge (1997) further suggests that traditional organization structures restrict communications between departments and make sharing experience difficult. In order to learn how to learn an organization should be viewed as a fluid system with complex interrelationships and in addition, a culture that rewards investigation and enquiry, which empowers people to experiment must be established (ibid.).

Managing knowledge and learning in the construction industry

Styhre, Josephson and Knauseder (2004) argue that know-how is primarily shared in construction projects through informal and personal contacts, and new arenas are needed where various professional groups can share knowledge and information, i.e. experience feedback can occur, for beneficial joint learning throughout projects. Dubois and Gadde (2002) identified patterns in the construction industry as tight couplings in individual projects and loose couplings in the permanent networks. Further, to handle the complexity within the industry, certain collective adaptions occur, where by collective knowledge is created and forms a shared understanding regarding what is done and how it is done. The nature of the construction industry can be regarded as several communities of practices depending on the roles the participants have in the projects (ibid.). These descriptions are consistent with conclusions drawn, for example, by Argyris (1995) regarding key elements for learning, Jonsson (2015) regarding influences of the organizational context on learning and Senge (1997) regarding the importance of interrelationships. To facilitate the sharing of knowledge and information in communities in order to promote joint learning one must consider both technological and social elements Huysman and Wulf (2005).

Proposition

Based on previous findings summarized above, the following proposition has been formulated. An appropriate knowledge management platform is a system that could tighten couplings between construction projects. For refurbishment projects, such a platform would include strong assets in processes, relationships and repetition of know-how. In addition, the effectiveness of a knowledge management system in project-oriented settings depends on individuals´ involvement in communication and discussion to foster learning during day-to-day work having a knowing in practice perspective.

METHOD

The Swedish contractor mentioned in the Introduction faces a qualitative problem, as the firm has an identified need for a method for managing knowledge regarding refurbishment of buildings that incorporates mechanisms to integrate experiences and reuse information. Merriam (2009) describes different views on qualitative research; the concerns about reliability, validity and generalizability and not least the subjectivity of the researcher and others involved in the study. However, both of the researchers have a background in construction and a pre understanding of the context, which increases the reliability and validity in the research. The research is performed

in the context of the construction industry and refurbishment. Further, by being open with both researchers´ backgrounds in construction, readers of the research can critically judge the result. Jansson, Johnsson and Engström (2014) regard platforms, in the construction context, as vehicles that can convey information between projects. At this stage in the research a platform is used as a pragmatic conceptual model that is treated, for the time being, as synonymous with a knowledge management system. The parent organization in a major Scandinavian construction company wants to collect experiences from temporary refurbishment projects undertaken by the organization regarding planning, logistics and handling of tenants. A manager from the parent organization, herein referred to as M, is responsible for collection of these experiences. M selected five ongoing temporary refurbishment projects to focus on in areas where there is continuity and an established operation: two in Denmark and three in Sweden. The projects are briefly described in Table 1.

M visited sites and attended meetings associated with these five projects. To obtain information and understand how knowledge is shared in practice one of the authors of this paper, hereafter the researcher, also attended the meetings, as an observer, and took notes covering 65 A4 pages in total. Observations as a research method is far from passive and ways in which perception of the same scene can vary from observer to observer depend on the observers´ background, culture and expectations Chalmers (1999). Also, the presence of the researcher does affect the meetings. Marvasti (2014) discuss different roles of an observer; peripheral membership, active membership and complete participant and state that "those roles are difficult to distinguish from one another" p.356. We argue that peripheral membership with marginal involvement in what is being observed is applicable in this study. Personnel present at each meeting included the manager from the parent organization, M, the site manager and the researcher.

Table 1: Brief description of the projects

Project	Number of apartments	Type of contracting	Scope
A	190	partnering	extensive refurbishment, from the original building only the concrete load bearing structure is left
B	838	main contractor	new façade with insulation, new windows, new ventilation, new roof with solar cells
C	160	mutual trust contract	new ventilation, new bathroom, new kitchen, new electricity, new water and sewage
D	1391	turnkey contractor	new bathroom, new window, new kitchen
E	436	turnkey contractor	new bathroom , new water and sewage

The researcher had meetings with M both before and after each meeting with the refurbishment projects´ site managers. This was done to obtain an understanding of the purpose of the visit and subsequently record M´s reflections to validate the empirical material.

Further reflections from M were also obtained 10 weeks after the fifth visit. The empirical materials from the project meetings and meetings with M have been separately processed and are separately reported here. Adopting an interpretivist approach, the researcher coded and categorized observations regarding three themes;

planning, logistics and handling of tenants. Findings from the coding were then analysed against the proposition.

FINDINGS

Findings related to planning, logistics and handling of tenants are presented below. The observations also yielded other interesting findings related to the conceptual framework in the context of refurbishment which are to be found under Additional findings.

Planning

A common feature of all five temporary refurbishment projects is that the site manager has a weekly meeting with the foremen, both company personnel and subcontractors, to monitor progress of the work and reconcile conflicts. Workshops were held at the launch of the two projects in Denmark, projects A and B, to harmonise expectations, establish rules, and delegate responsibility. Time schedules were also developed, together with subcontractors, during workshops. Project B´s site manager emphasised the importance of those who will actually do the work suggesting solutions. Similarly project A´s site manager said that working in this manner, e.g. with workshops, provides a helpful climate that promotes cooperation and reduces conflicts, making everything smoother and more efficient. In both projects C and E there is a main time schedule, and more detailed schedules are produced showing work planned 2 to 4 weeks ahead. The site managers in projects A, C, and E expressed the importance of including time buffers in the schedules to allow later adjustments. Project D´s site manager described his view on planning; “I walk around the site every day and directly address problems as they arise. Just sitting in the office working with time schedules increases the risk of losing awareness about what is happening at the construction site, which results in losses in production time”. The site managers for projects D and E said they often use the same subcontractors in different projects. According to the former; “this is a very special job and we cannot bring in just anyone, we are a closely-knit gang”. In projects C and D the renovation work is planned to allow the tenants to stay in their apartments during Christmas and summer holidays, and the site manager of project C argues that this prolongs the renovation work, but the tenants' wellbeing is more important.

Logistics

In project A there are weekly meetings to provide information about incoming deliveries. The site manager of project B mentioned the importance of disseminating such information. Participants in project A have invented a crane solution so they do not need to rent a crane. To avoid exposing tenants to risks when walking back and forth to their apartments, the site managers of projects B and C say that fences have been erected to keep the tenants away from the renovation area. The site managers in projects B and C emphasize the importance of planning the scaffolding to facilitate transportation of material and ensure the working height is appropriate. In projects C, D and E demolition-materials are often brought out through windows. Generally, there are storage limitations, because of lack of space or restrictions imposed by the landlord.

Handling of tenants

In project A, there are no tenants left in the building complex during the renovation. In each of the projects B, C, D, and E the landlord has appointed someone to have responsibility for contact with the tenants. The site manager in project C said that

having a designated person at the construction site with the main task of taking care of everything related to the tenants has been one of the project´s successes. The site managers in projects B, C and E also emphasise the need for workers with renovation experience, where there is daily contact with tenants. Further, project C´s site manager argues that ideally the same workers should be involved throughout the renovation process, as it makes the tenants more comfortable. Safe management of keys is also important. In project B the person responsible for the tenants also takes care of the keys and they are handed over to workers who need them on the days they will be used, while in projects C and D the person responsible for the tenants takes care of the keys and the contractor changes key cylinders. Also, the doors must be locked all the time. Finally, in project E a digital key management system is used.

M´s reflections

According to M much of the work carried out on refurbishment projects is strongly linked to people. In the future, people with more than 30 years of experience will not be available in the organization, because every building is different so systematization of experiences will provide no direct technology-related benefit for the parent organization. However, it may provide benefits regarding processes like planning, logistics and handling of tenants. M argues that managers need to take the time to visit each other´s construction sites, as it provides a relatively cheap and easy way to exchange experiences. In the future M thinks that developing a training package incorporating practices for handling processes for logistics and planning would be highly valuable, and that several actors should be involved in planning systems.

Additional findings

The site manager in project B emphasizes; “the workers are doing most of the detailed planning work, e.g. during lunch breaks, cooperation takes place and the whole project benefits”. Also, the workers are in the same stairwell when carrying out their respective tasks which mean they are constantly updated on the work progress and can plan when next task can start. The site manager in project B further argues; “technically refurbishment is uncomplicated, and the key for success is to have a well-functioning logistics”. In addition, information to tenants is essential, both before and during the refurbishment, a fact which also is underlined by the site managers in projects A, C and E. The site manager at project C emphasizes; “firstly, since the tenants stay in their apartments during refurbishment and move around near the refurbishment area it is very important to keep schedules and use transport routes where we interfere the least possible.

Secondly, if we are to be skilled at refurbishment, mistakes must be accepted especially in the beginning, we will gain experience and the outcome from coming refurbishment projects will get better”. The site manager from project E argues; “I have conducted a number of refurbishment projects and it is important that I am involved early in the tendering process to avoid unnecessary mistakes, we also have a person, i.e. a project manager, responsible for all projects in the region and once a week the project manager visits every construction site and coordinates the work”. M comments; “what you are doing here, i.e. in project E, is not done easily and managers from other regions need to come and visit”. Finally according to the site manager at project C; “it is the site manager who creates the atmosphere at the construction site”. Also, the site manager at projects D argues; “it is difficult to get good workers who contribute to the team spirit” and M fills in; “they want to work on a construction site only a few years and then they want to advance their carriers”.

DISCUSSION AND CONCLUSION

According to the formulated proposition, processes, relationships and know-how are important elements of a knowledge management platform for refurbishment. The findings presented here regarding the benefits of weekly meetings with the contractor´s own personnel and subcontractors to reconcile work progression confirm the importance of focusing on processes and relationships and individuals´ involvement. This is underlined by Jawernick- Will (2012) who states that processes of locating, providing and reusing knowledge largely occur on the micro, individual level. That know-how mainly is shared through informal, personal contacts Styhre, Josephson and Knauseder (2004) is highlighted by the practitioners´ expressed approval of workshops with subcontractors to develop time schedules and establish expectations, safe management of keys, and appointing someone to have responsibility for contact with tenants. Additionally, the statement by the site manager B that the workers are doing much of the detailed planning and when working in the same stairwell are constantly updated are other examples of how know-how is shared informally. Further, the expressed need for workers with experience of refurbishment, especially experience of daily contacts with tenants, confirms the importance of individual involvement and knowing in practice as described by Jonsson (2012). Also, findings regarding the meetings associated with project A and B, workshops with subcontractors, and M´s comment that managers should visit each other´s construction sites to exchange experiences, confirm that key elements of a knowledge management platform for refurbishment are communications and discussions about learning and having a knowing in practice perspective.

Finally, the importance of a coordinating function in refurbishment projects has been disclosed and is exemplified by; “the key for success is to have well-functioning logistics” (site manager B), “it is very important to keep schedules and use transport routes where we interfere the least possible” (site manager C) and “a person responsible for all projects in the region visits every site once a week and coordinates the work” (site manager E).

There are clear indications that a platform can provide a useful vehicle for conveying information between refurbishment projects, but the optimal ways to handle tacit knowledge are still unclear. A working method for communicating and collecting tacit knowledge must be developed and a coordinating function must be included within a platform as it is crucial for successful knowledge management. The presented results indicate that applying a knowing in practice perspective and developing a working method may be more fruitful than developing an information technology system.

ACKNOWLEDGEMENT

The authors would like to thank the Swedish construction industry´s organisation for research and development (SBUF) and The Swedish research council Formas for funding this study. In addition, we would like to thank the participants in the observations for their valuable time.

REFERENCES

Alvesson, M (2004) *Knowledge Work and Knowledge-Intensive Firms*. New York: Oxford University Press Inc.

Alvesson, M and Kärreman, D (2001) Odd Couple: Making sense of the curious concept of knowledge management. *Journal of Management Studies*, **38**(7), 995-1018.

Argyris, C (1995) Action science and organizational learning. *Journal of Managerial Psychology*, **10**(6), 20-26.

Chalmers, A F (1999). *What Is This Thing Called Science? 3rd Edition*. Buckingham: Open University Press.

Cyert, R M and March, J G (1963) *A Behavioral Theory of the Firm*. New Jersey: Prentice-Hall, Englewood Cliffs.

Dave, B and Koskela, L (2009) Collaborative knowledge management: A construction case study. *Automation in Construction*, **18**(7), 894-902.

Dubois, A and Gadde, L E (2002) The construction industry as a loosely coupled system: Implications for productivity and innovation. *Construction Management and Economics*, **20**(7), 621-631.

Easterby-Smith, M and Lyles, M L (Eds.) (2011) *Handbook of Organizational Learning and Knowledge Management 2nd edition*. Oxford: Blackwell Publishing.

Formas (2012) Miljonprogrammet:utveckla eller avveckla? Stockholm: Edita AB (Swedish).

Hall, T and Vidén, S (2005) The Million Homes Programme: a review of the great Swedish planning project. *Planning Perspectives*, **20**(3), 301-328.

Hislop, D (2009) *Knowledge Management in Organizations: A Critical Introduction 2nd Edition*. Oxford: Oxford University Press.

Huysman, M and Wulf, V (2005) The role of Information Technology in building and sustaining the relational base of communities. *The Information Society: An International Journal*, **21**(2), 81-89.

Jansson, G, Johnsson, H, and Engström D (2014) Platform use in systems building. *Construction Management and Economics*, **32**(1-2), 70-82.

Jawernick-Will, A (2012) Motivating knowledge sharing in engineering and construction organizations: Power of social motivations. *Journal of Management in Engineering*, **28**(2), 193-202.

Jonsson, A (2012) *Kunskapsöverföring Och Knowledge Management*. Malmö: Liber AB (Swedish).

Jonsson, A (2015) Beyond knowledge management: understanding how to share knowledge through logic and practice. *Knowledge Management Research & Practise*, **13**(1), 45-58.

Lam, A (2000) Tacit knowledge, organizational learning and societal institutions: An integrated framework. *Organization Studies*, **21**(3), 487-513.

Lessing, J, Stehn, L and Ekholm, A (2015) Industrialised house building- development and conceptual orientation of the field. *Construction Innovation*, **15**(3), 378-399.

Marvasti, A.B. (2014). The Sage handbook of qualitative analysis. *In*: U Flick (Ed.) *Analysing Observations*. London: Sage Publications Ltd, 354-367.

Meiling, J (2010) *Continuous Improvement and Experience Feedback in Off-Site Construction: Timber-Framed Module Prefabrication*. PhD thesis, Department of Civil, Environmental and Natural Resources Engineering, Luleå University of Technology.

Merriam, S B (2009). *Qualitative research: A Guide to Design and Implementation*. San Francisco: Jossey-Bass.

Meyer, M H and Utterback, J M (1993) The product family and the dynamics of core capability. *Sloan Management Review*, **34**(3), 29-47.

Newell, S (2015) Managing knowledge and managing knowledge work: What we know and what the future holds. *Journal of Information Technology*, **30**(1), 1-17.

Nonaka, I and Takeuchi, H (1995). *The Knowledge-Creating Company: How Japanese Companies Foster Creativity and Innovation for Competitive Advantage*. New York: Oxford University Press.

Polanyi, M (1983). *The tacit dimension*. Gloucester: Peter Smith.

Robertson, D and Ulrich, K (1998) Platform product development. *Sloan Management Review*, **39**(4), 19-31.

Senge, PM (1997) The fifth discipline. *Measuring Business Excellence*, **1**(3), 46-51.

Styhre, A and Gluch, P (2010) Managing knowledge in platforms: Boundary objects and stocks and flows of knowledge. *Construction Management and Economics*, **28**(6), 589-599.

Styhre A, Josephson P E and Knauseder I (2004) Learning capabilities in organizational networks: Case studies of six construction projects. *Construction Management and Economics*, **22**(9), 957-966.

Thuesen, C and Hvam L (2011) Efficient on-site construction: Learning points from a German platform for housing. *Construction Innovation*, **11**(3), 338-355.

Tsoukas, H (2003) Do we really understand tacit knowledge? *In*: M Easterby-Smith and M A Lyles (Eds.) *The Blackwell Handbook of Organizational Learning and Knowledge Management*, Oxford: Blackwell Publishing.

IDENTIFYING THE COMPLEX INFORMATION REQUIREMENTS OF SUSTAINABLE DRAINAGE SYSTEMS

David Boyd[1] and Antony Taft

School of the Built Environment, Birmingham City University, Millennium Point, Birmingham, West Midlands, B4 7XG, UK

The management of water both for supply and removal is a growing concern of society. The primary purpose of sustainable drainage systems (SuDS) is to address the flow and volume of run-off from impermeable surfaces that are formed in the development of the built environment. SuDS involves a number of methods to store run off and release it in a controlled manner and to permit infiltration into the ground. This is often achieved through a 'management train' involving a number of methods arranged in a series and a number of landscape features such as basins, swales, permeable paving, grass filter strips, gravel strips and soil infiltration. Designing these effectively produces many benefits other than water removal including groundwater recharge, water resource, landscape enhancement and biodiversity. However, this requires addressing multiple objectives which make the problem extremely complex and involves the support of many disciplines and stakeholders. It has been proposed that infrastructure information modelling will make the design and management of SuDS easier and more robust. In order to explore the viability of this, this paper identifies the multiple and complex information requirements in the design and management of SuDS through an analysis of a design case study. It considers the different stakeholders and their different information needs. Information is of various types and qualities which forces a developmental approach to design. These differences are not acknowledged in current infrastructure information modelling which seeks to automate the process in a single comprehensive model. The paper concludes that new forms of models need to be created that can use different information qualities and allow a more interactive design between stakeholders.

Keywords: multiple models, complexity, decision making, stakeholders

INTRODUCTION

Water is a fundamental necessity for humans but it is significantly problematic characterised by drought or flood. The human management of water has been undertaken for millennia and the success of this was needed for societies to flourish. The management of water has developed over time seeking improvements by managing more comprehensively, faster and with greater certainty. Sustainable Drainage Systems (SuDS) are the default method for surface water management of new developments in the UK and are now being retrofitted in locations where flood prevention can be enhanced (Boscher *et al*., 2007). The basic purpose of SuDS "is to mimic, as closely as possible, natural drainage of a site in order to minimise the impact that urban development has on flooding and pollution of rivers, streams and

[1] david.boyd@bcu.ac.uk

Boyd D and Taft, A (2016) Identifying the Complex Information Requirements of Sustainable Drainage Systems. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 729-738.

other water bodies" (Wilson *et al*., 2004). SuDS therefore reduces flooding and pollution by providing natural methods of drainage like swales, ponds, basins, infiltration trenches, green roofs and wetlands. Other methods can also be employed such as permeable paving and rainwater harvesting, which may not be natural, but which allow for water to be stored and infiltrate into the ground similar to natural systems or to recycle water for use. As the beliefs in undertaking this SuDS water management have increased, many other advantages of SuDS have been realised for example: groundwater recharge, pollution control, landscape amenity, energy supply, and biodiversity enhancement. These increasingly complex requirements are making it more difficult to design effective and efficient systems.

The construction design world is being challenged to enter the digital information era, particularly as Building Information Modelling (BIM), in order to construct buildings more effectively, cheaply and faster. Although there is less impetus, a similar development is happening with infrastructure (Stasis *et al*., 2012) with its greatest drive being in railways, bridges and roads. It would appear that there are many opportunities for developing Infrastructure Information Modelling that would allow the more accurate design of systems more rapidly but also the integration of many more features into design and the delivery of greater certainty. What Infrastructure Information Modelling needs to be is an integrated platform for collaborative working bringing different computer modelling packages together and providing a repository for the extensive information that can be managed in the long term. However, there is very little development of comprehensive models in the SuDS field. This is strange as this field is heavily engineering based and has been using calculative methods and computer modelling for many years.

The success of the modelling world in changing the way manufacturing engineering design and development have been undertaken is legendary (Bailey 2012) with Finite Element Analysis and Computational Fluid Dynamics being ubiquitous tools now for the analysis and design of many systems. There is a question then about why SuDS has not been one of the first to develop an integrated information model. This paper will investigate this by considering the nature of the SuDS modelling problem and what information is required to make decisions on the design and management of such drainage systems. The work takes a critical look at modelling as a whole by exploring how information is transformed into knowledge through the analysis of a case study of a design situation. It considers the different stakeholders and their different information needs. Information is of various types and qualities which forces a developmental approach to design. Design involves complex multi-party judgements which are not acknowledged in BIM based infrastructure information modelling which seeks to automate the process in a single comprehensive model. The paper concludes that new forms of models are needed which work with these different information qualities, which inform the decision process, and which allow a more interactive design between stakeholders.

METHODOLOGY

The research reported here sought to gain a richer understanding of design approaches and the use of models for SuDS. This required an understanding of knowledge about drainage and natural environments and also of decision making with this knowledge. This work took a critical realist position (Mingers 2000) and used case study methods as the exploration was in a pilot phase. A single case study was used as this was sufficient to present the complexity of the design and modelling situation. The case

was based on the design work of one of the authors which allowed an added insight into the problematic nature of design. Any bias from this was considered less important in this pilot work; the access to rich data being most important at this stage of the research. Mingers (2008) work is particularly suitable for the analysis of information systems as it provides a breakdown of knowledge. Mingers (2008) discusses the fundamental issue of the way that knowledge relates to truth. He questions how we accept what knowledge is arguing that there is not just one kind of knowledge or truth. The idea that data, information and knowledge are different has been discussed by Grover and Davenport (2001) who put knowledge at the top of the hierarchy which they deem to be information supported by insight, experiences, context and interpretation. Mingers (2008) offers four different types of knowledge: propositional, experiential, performative and epistemological. This breakdown is used to explore the case study and the more general SuDS design situation. Propositional knowledge is knowing based on combining declarative statements; experiential knowledge is based upon our personal experience of situations; performative knowledge is knowing how to do something in a social situation; finally, epistemological knowledge is knowing as a result of formal logical methods.

THE NATURE OF THE SUDS DESIGN PROBLEM

The SuDS design problem is technical, economic and social. In its basic technical analyses SuDS involves a hydrological model. Early hydrological models were lumped deterministic models which dealt with entities and variables as single units for example rainfall and runoff (Lundin *et al*., 2000). These enabled a gross understanding of situations but were not useful for details of local design. As these models were developed they could represent more physics of the situation which allowed much clearer analysis with information tied more closely to real features of a situation. These physically based distributed parameter models were then developed in 3 dimensions using meshes which allowed them to be connected to maps (Abbott *et al* 1986), and with the advent of low cost computers allowed the adoption of digital techniques within the field.

Much of the current approach has been developed through experience and uses empirical equations developed a number of years ago (Marshall and Bayliss, 1994) rather than fully modelled analyses. In current approaches (Ellis *et al*, 2011, Wood-Ballard *et al*., 2007, EA 2010) designers need to know details of topography, level and type of pollutants, soil permeability, groundwater level, volume of flow and permissible discharge rate from the site. Engineers therefore use design software which allow analysis of the hydrological aspects which consider supply of water, flows of water and how the landscape stores this; this permit them to set sizes and levels for the various components. The key input data is rainfall. Future rainfall cannot be known for any instance but must be estimated by intensity, duration and likelihood from past data. Design is then conducted against once in one-year events which occur frequently, once in 30 year events which present the maximum capacity of the system and finally 1 in 100 year events which present the consequences and risks of flooding.

However, these basic requirements are now being extended and the issues that need to be considered are increasing and this is changing the way that choices are made about various SuDS elements and therefore SuDS design has become much more complex. In the last 15 years there has been much more attention to pollutants, with particular focus on their impact on sensitive underground aquifers (Ellis *et al*., 2012, Woods-

Ballard *et al*., 2015). This introduces both particulate pollutants and chemical pollutants to the situation which require different approaches to design. This requires models to be able to assess chemical and biological transfer and reaction (Hatt *et al*., 2007) which are based on a totally different basis to hydraulic models. Given that the variability and uncertainty of the situation is so evident, hydrological modelling has also been based on stochastic analysis which produced statistical data (Wagener *et al*., 2001). This working with uncertainty of the situation has also been developed using neural networks and Bayesian techniques.

The design situation is also socially constrained. In practice this involves consideration of land ownership and amenity value to satisfy planning conditions. This often requires Landscape Architects to be involved to consider proposed ground contours and sympathetic planting schemes again introducing a different perspective on the modelling. Inevitably, the cost in relation to benefit of the solutions adopted are challenged and the stakeholders argue about responsibilities for payments (Royal Haskoning, 2012) again producing different perspectives on approaches and solutions.

In order to try to rationalise the complexity of the situation so that decisions could be made, Ellis *et al*., (2011) devised a decision support system (DSS). This identified the key criteria needed to ensure that all requirements are satisfied or at least addressed. Table 1 shows the key criteria which the various stakeholders wish to be satisfied and the indicators which allow each of the criteria to be investigated and satisfied within a multi-criteria analysis (MCA).

Table 1: Criteria and indicators within the MCA (Ellis et al., 2011)

Criteria (Areas of Concern)	Indicators
Technical	Flood Control
	Pollution Control
	System Adaptability
Environmental	Receiving Water Volume Impact
	Receiving Water Quality Impact
	Ecological Impact
Operation and Maintenance	Maintenance and Servicing Requirements
	System Reliability and Durability
Social and Urban Community Benefits	Public Health and Safety Risks
	Sustainable Development
	Public/Community Information and Awareness
	Amenity and Aesthetics
Economic	Life Cycle Costs
	Financial Risk/Exposure
	Long Term Affordability
Legal and Urban Planning	Adoption Status
	Local Building and Development Issues
	Urban Stormwater Management Regulations

Ellis *et al*., (2011) accept that MCA is “not intended to be a SuDS drainage design approach and other hydraulic and water quality methodologies will need to be referred to in order to properly dimension individual SuDS devices”.

The above literature identifies the complexity of information required for SuDS, with different disciplines requiring different information and interpreting common

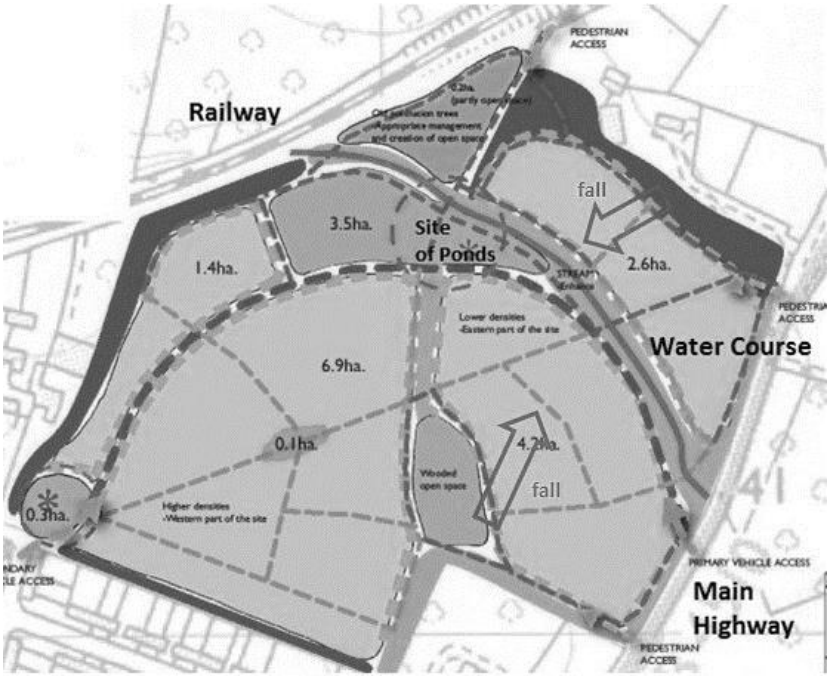
information in different ways. This makes the practical application more difficult to apply in the real world where there are also regulations and standards.

A SUDS CASE STUDY

Case context

The case study involved the design of a drainage system for a proposed residential development located in Evesham, Warwickshire on substantially undeveloped land shown in Figure 1. A Strategic Flood Risk Assessment was unavailable but the nearest flooding was at least 3.5m below the lowest site level. The topographic survey indicated that the site fell in two directions from high points on the southern and north-east boundaries to a watercourse crossing the site. The difference in level between the highest and lowest points on the site was approximately 15.0m. The site fell into Zone 1 – Low Probability flood risk.

Figure 1, Map showing layout of site (Courtesy THDA Consultants Ltd)



Ground Investigation identified made ground up to 450mm thick or low plasticity clay up to 600mm thick under topsoil at shallow depth. This was underlain variously by gravely sand in the south of the site up to 2.0m deep, to firm-to-stiff clay in the north of the site up to 3.0m deep. Groundwater was not encountered in most boreholes. There was a minor aquifer just into the northern boundary and under a small area at the southern boundary. The site was not within an Environment Agency groundwater source protection zone, so infiltration techniques would be feasible into the gravelly sand area, dependent upon contaminant levels.

Local authority records indicated that the watercourse crossing the site was not a critical ordinary watercourse and had a catchment substantially within the development area. The average gradient of the watercourse bed was 1 in 48, for a bed width of approximately 500mm and depth between approximately 0.79 and 1.5m. The minimum distance between the top of the banks was approximately 3.8m. Hydraulic modelling showed the channel capacity to be at least 6 m3/s.

Further Hydraulic Modelling used IOH 124 (Marshall and Bayliss, 1994) to provide the greenfield run-off for 200 years at 39.1l/sec for the north area and 285l/sec. for the south area. The public highway draining to the ditch would generate run-off of approximately 80l/sec thus the ditch had considerable available capacity.

There were no local adopted sewers shown on sewer records and the nearest public surface water sewers could be utilised only by employing pumping (generally unacceptable to Water Authorities) and these would require works to increase capacity. Design criteria required that discharge from the southern section of the future development needed to be limited to 84.5l/sec and the northern section to 11.6l/sec. Modelling indicated that the total surface water discharge generated by the proposed development for the worst case 100 year plus 30% storm (EA climate change allowance) would be approximately 1400l/sec if road and roof areas over impermeable strata contribute to the flow.

Drainage strategy

The strategy was based on approximately 470 dwellings in the southern part. Of these, 322 with drives or parking spaces would be outside the area to be drained using infiltration techniques. A variety of SuDS methods could be utilised. House soakaways, permeable paving and infiltration strips would be used outside the adoptable highway to utilise the higher permeability areas. A 185mm thick sub-base with a 30% voids ratio would provide the required attenuation storage. The remainder of the site would have a piped network draining via ponds to an attenuated discharge.

The total impermeable area of land south of the watercourse is 6.7Ha. Post development run-off rates for the north and south drainage systems were modelled for storms of 1, 2, 30 and 100 years plus 30% to account for climate change. Pond modelling confirmed that the hydrobrake outflow would never exceed the limiting discharge. Due to ground levels and space a cascaded pond system was proposed in an area which could be offered as Public Open Space. Thus, the ponds would be adopted by the local authority as part of the Open Space. Modelling indicated that drainage systems would not flood for storms up to 30 years in compliance with requirements for adoptable drainage systems. The 100year + 30% storm would cause upstream flooding for the worst case storm of 252 cu m distributed across the development. This flood storage would be provided by swales, voided sub-base and/or filter strips in private areas. In cases of blockage water would gravitate to the watercourse.

DISCUSSION

The Nature of SuDS modelling

The design situation is multi-layered at different scales, multi stakeholder and multi-knowledged. The case study shows the different uses of knowledge and this can be explored using Mingers (2008) categories: propositional, experiential, performative and epistemological. The complexity and inter-disciplinary nature of SuDS design involves many assumptions, which limits model representativeness. Given this indeterminacy and the many different stakeholder perspectives means that the basic approach is Performative. That is practitioners work in a negotiative environment of decision making based on the expectations of their roles. Thus, civil engineers provide the hydrological input, landscape architects the landscape form and planting input, the planners the regulatory and consultative input and agencies argue for more environmental resilient work. This is supported by the experiential nature of much of

the knowledge meaning individuals having a great sway in decisions. In this professionals know what works because they have done it before. They use epistemological knowledge from models but only to interrogate situations and to validate decisions already made. These decisions become Propositional knowledge over time and can be embedded in codes, regulations and toolkits. Thus Kirkham and Rayner's (2007) can state that "SuDS design has traditionally been simplistic, using basic equations and 'rules of thumb' often leading to conservative designs".

The information required to satisfy the criteria for a SuDS decision support is in numerous forms; some numerical, others textual and still others diagrammatic. Further SuDS design involves the detailed involvement of different disciplines who see the nature and use of models differently. Voordijk (2008) acknowledges this more generally for the built environment, by placing knowledge in three disciplines - sciences, humanities and design. Each of these is operational within the SuDS design situation. Different disciplines use this information differently each with their own evaluation and effectively own model. The scientific and epistemological models of the engineers are contrasted to the Humanities and propositional models of the planners. Paolisso *et al*., (2013) identify that humanities models are to improve dialogue, create policies and generate (environmental in this case) solutions. Thus, part of the differences is the way each discipline views models.

Set within this complexity there are different qualities of information and a difficulty in assessing what that quality is. In the multi stakeholder environment these are viewed differently and seen with different risks. The engineer is producing an answer within this i.e. performative knowledge, which is convincing to the environment agency and the client set within industry norms and standards. They are concerned that if the design was audited (or challenged later) it would stand up to a duty of care analysis based on norms. In order to undertake this, the engineer has a design path that develops as information is transformed to usable knowledge as it is accessed, created and assessed. This starts from early information accessed from library sources and local knowledge. Designers are aware that this could be of low and variable quality and this is factored into the decisions about what other information to seek (e.g. site investigations) and even what solutions are viable. Site investigations cost money and doing more may not be valuable as they only sample the ground formation; it is experiential knowledge that requests greater density in identified sensitive areas where if there was an error, there are large implications. There is still the possibility of not detecting an underground feature which alters the performance of the landscape from that expected. Questions then arise of priorities and risks which again must be modified by costs of solutions, multiple benefits and stakeholder views.

Contrasting SuDS and BIM led infrastructure information modelling

This understanding is not considered within BIM led Infrastructure Information Modelling. Again using Mingers (2008) categories, the BIM view is driven by Epistemological knowledge where the model substantively represents reality. It is this modelled reality which becomes the Propositional knowledge based on a discourse of accuracy and optimisation. Thus it is the modelling that is Performative in BIM and different disciplines are expected to share experiences of the model world. This leads to the Experiential being about the operation of models. In BIM then it is the accuracy of the data that is key and this data is fundamentally tied to geometric forms. In buildings, particularly new buildings, it is possible to place the geometry with as much accuracy as is needed and engineering concepts of tolerances become critical.

In a natural real world situation, that SuDS works in, such notions of accuracy, complete knowledge and control of the situation are fundamentally not available. The world of SuDS design is basically an empirical experiential world. The number of variables and the dynamic nature of these make the modelling problem extremely complex. In currently practice, models are used for designers to understand a situation rather than to solve the design problem. One of the key issues is that as models become more complex they have a greater demand for input information; thus, although they may be more accurate and represent more factors, they require more assumptions and a greater quantity of input data. The variability of the quality of input data limits the validity of the model and the ability to trust the output data. It also makes it much more difficult to validate the model using measured data from live situations. It is also the case in SuDS modelling that input parameters must be estimated for extreme conditions not just average conditions thus removing the ability to cancel out data noise and errors. This variability is often dealt with statistically but for the designer it is the exceptional situation that must be considered.

The Needs for new SuDS modelling

The term 'model' is used regularly throughout the construction industry but it is seldom acknowledged that there are differences in its use with implications that are rarely explored. The term has been commandeered by the BIM movement who demand a single authoritative view featuring a comprehensive integrated model accessing data from a common data environment. However, the key issue is expressed often by SuDS practitioners, e.g. Kirkham and Rayner (2007), ‘models are simplified systems that represent real systems’. The word “simplified” is significant, and it is the reduction in complexity that makes models operable but this limits their representativeness of real worlds. Thus, it is important to recognise that models contain idealizations, simplifications, approximations, and fictional entities such that they can be rendered “hopelessly inaccurate” Knuuttila (2011). This is particularly the case with SuDS where it is the differences in the quality of information and the differences in the way people see information that needs to be supported.

The nature of the SuDS modelling situation is not the same as BIM as it is based on natural systems. There are no fixed reference objects to base parametric data on and the features do not connect together in a way like geometry. Global Information System (GIS) representations provide a gross view of a situation with a very grainy topography. In addition, there is a graininess about the distribution of soil types where for SuDS it is the interaction of soil types and other physical features that create water flow paths and different conditions of storage. This is made worse by the situation being dynamic. There are different time periods, important in different situations with long term changes dictating changes in rivers whereas in floods short term changes in conditions (such as a tree blocking a drainage channel) which dictate the changes in the developing situation. This requires a variety of models and each with different possibilities for interpretation. The various possible time perspectives are seen with different importance to each profession. Even for the civil engineer the difference between long term hydrological management is contrasted by the short term consequences of extreme weather events. Similarly, the landscape architects understanding of the long term control of soil water through landscape and planting features is contrasted by the engineers' desire for short term predictability of water movement. Placing this complexity against a decision about how much to spend on a SuDS scheme, and how much risk that might be acceptable, can only be handled through a collective value judgement at the point of decision making.

We are left then recognising that a comprehensive integrated model for SuDS is not possible and even a common data environment has in-built problems. SuDS requires a multi model environment with the models being decision support tools for an inter-disciplinary team. The indeterminate nature of much of the information is handled by developing decisions progressively rather than seeking all the information from which a solution is calculated; information and knowledge are co-produced. Modelling tools can be improved to undertake this but this needs to be driven by the need for collective comprehension and communications rather than for individual accuracy and comprehensiveness. This has learning for BIM situations as they also contain many natural situations which do not yield to modelling in the way BIM assumes. There is a temptation to force situation to be like the model rather than to create models that better represent situations. This understanding drives us to see SuDS models differently basically as decision support tools.

CONCLUSIONS

The demands in our modern world for infrastructure certainty and for environmental responsibility, within budget constraints, drive modern design and development approaches. This drive is pressurising us to believe that the whole process can be solved by computer software models so long as they are written correctly. There seems also to be a belief that all knowledge related to a problem can be identified and that choices and decisions can therefore be substantially automated. As this paper has shown, models for SuDS can exist only to support decision making and even these are subject to multiple assumptions and approximations in the parameters that they can employ. These differences are not acknowledged in current infrastructure information modelling which seeks to automate the process in a single comprehensive model. In conclusion, it is recommended that; more work needs to be done revealing the use of knowledge in SuDS design case studies; new models need to be created for natural systems that can utilise different input information qualities and perspectives; and models need to allow a more interactive design between stakeholders.

REFERENCES

Abbott, M B, Bathurst, J C, Cunge, J A, O'Connell, P E and Rasmussen, J (1986) *An introduction to the European Hydrological System - Systeme Hydrologique European, "SHE"*. Journal of Hydrology, 87(1-2), 45-59 and 61-77.

Bailey, D E, Leonardi, P M and Barley, S R (2012) The lure of the virtual. *Organization Science*, **23**(5), 1485-1504.

Birch, G F, Fazeli, M S and Matthai, C (2005) Efficiency of an Infiltration Basin in removing contaminants from urban stormwater. Environmental Monitoring and Assessment, **1 01**(1), 23-38.

Boscher, L, Carrillo, P, Dainty, A, Glass, J and Price, A (2007) Realising a resilient and sustainable built environment: Towards a strategic agenda for the United Kingdom. *Disasters*, **31**(3), 236-255

Ellis J B, Lundy, D and Revitt J M (2011) An integrated decision support approach to the selection of sustainable urban drainage systems. SWITCH Conference: *The Future of Urban Water; Solutions for Livable and Resilient Cities, UNESCO, 24th-26th January 2011, Paris*.

Ellis J B, Revitt J M, and Lundy, D (2012) An impact assessment methodology for urban surface water runoff quality following best practice treatment. *Science of the Total Environment*, **416**, 172-179.

Environment Agency (2010) *Preliminary Flood Risk Assessment: Final Guidance Report*. GEH01210BTGH-E-

Grover, V and Davenport, T (2001) General perspectives on knowledge management: Fostering a research agenda. *Journal of Management Information Systems*, **18**(1), 5-21.

Hatt, B E, Fletcher, T D and Deletic, A (2007) Hydraulic and pollutant removal performance of stormwater filters under variable wetting and drying regimes. *Water Science & Technology*, **56**(12), 11-19.

Kirkham, R and Rayner, C (2007) Best practice for modelling sustainable urban drainage system structures. *In*: *Proceedings of 13th International Conference in Rainwater Catchment Systems, Sydney Australia*. Warwick: International Rainwater Catchment Systems Association.

Knuuttila, T (2011) Modelling and representing: An artefactual approach to model-based representation. *Studies in History and Philosophy of Science*, **42**(2), 262-271

Lundin, L-C, Bergström, S, Eriksson, E and Seibert J (2000) Hydrological models and modelling. In Lundin, L-C (Ed) *Sustainable Water Management in the Baltic Sea Basin: The Waterscape 2nd Edition*. The Baltic University Programme, Uppsala University, 129-140.

Marshall, D C W and Bayliss, A C (1994) *Flood Estimation For Small Catchments, Report No 124*. Wallingford, Oxon: Institute of Hydrology.

Mingers J (2000) The contribution of critical realism as an underpinning philosophy for OR/ MS and systems. *The Journal of the Operational Research Society*, **51**(11), 1256-1270.

Mingers, J (2008) Management Knowledge and Knowledge Management: Realism and Forms of Truth. *Journal of Knowledge Management Research and Practice*, **6**, 62-76.

Paolisso, M Weeks, P, Packard, J (2013) A cultural model of farmer land conservation. *Human Organisation*, **72**(1), 12-22.

Royal Haskoning UK Ltd (2012) *Costs and Benefit of SuDS*. Final Report to Committee on Climate Change. July, Peterborough, UK: Royal Haskoning UK Ltd.

Stasis A, Whyte J, Stephens E and Dentten R (2012) *Building Information Modelling and Management in Infrastructure Programmes: A Scoping Study in Crossrail*. Technologies for Sustainable Built Environment Conference, Reading

Voordijk, H (2009) Construction management and economics: The epistemology of multi-disciplinary design science. *Construction Management and Economics*, **27**(8), 713 - 720

Wagener, T, Boyle, D P, Lees, M J, Wheater, H S, Gupta, H V and Sorooshian, S (2001) A framework for development and application of hydrological models. *Hydrology and Earth System Sciences*, **5**(1), 13-26.

Wilson, S Bray, R and Cooper, P (2004) Sustainable drainage systems: Hydraulic, structural and water quality advice. CIRIA Report C609.

Woods-Ballard, B, Kellagher, R, Martin, P, Jeffries, C, Bray, R and Shaffer, P (2007) *The SuDS Manual, Report C697*. Construction Industry Research and Information Association.

Woods-Ballard, B, Wilson, S, Udale-Clarke, H, Illman, S, Scott-Grant, T, Ashley, R and Kellagher, R (2015) *The SuDS Manual Report C753*. Construction Industry Research and Information Association.

INFORMATION FLOWS IN HIGHWAY PROJECT DELIVERY

Tom Bartley[1], Chris McMahon[2] and Steve Denton[3]

[1] *Systems Centre, Faculty of Engineering, University of Bristol, Queens Building, University Walk, Bristol BS8 1TR, UK*

[2] *Department of Mechanical Engineering, Faculty of Engineering, University of Bristol, Queens Building, University Walk, Bristol BS8 1TR, UK*

[3] *WSP | Parsons Brinckerhoff, Kings Orchard, Queen Street, Bristol, BS2 0HQ, UK*

Transport infrastructure projects involve many stakeholders sharing information across organisational and temporal boundaries. The growing use of Building Information Modelling requires closer alignment of processes for the creation, distribution and validation of project information across stakeholders, but this topic has had little scrutiny in the linear infrastructure sector and is poorly understood by clients or major suppliers. The aspiration of this paper is to understand the information flows from project inception to handover and surface some of the challenges in developing common or complementary protocols. This paper presents the results of a qualitative interpretivist study into the delivery of highway projects. Following 11 semi-structured interviews with members of different parts of the supply chain and the collation of published and unpublished project and corporate documentation which have been transcribed and coded, a conceptual IDEF0 model of the information flows associated with projects is presented. The outputs of this research highlight the challenges facing project teams in implementing information management practices and the paper and document based information exchange which pervades through standards, contracts, deliverables and quality management.

Keywords: information management, Building Information Modelling, organizational analysis

INTRODUCTION

The UK Government is pushing for innovation across the construction supply chain by requiring Building Information Modelling (BIM) Level 2 adoption on all its projects. BIM, as defined by the UK Government, requires asset owners to adopt a lifecycle approach to the creation, management and exchange of project and asset information, mandating that suppliers meet the requirements laid out in a suite of standards sponsored by the BIM Task Group.

There is emerging industrial and academic research into how BIM concepts can theoretically be applied to highway projects (Mawlana *et al*., 2015; e.g. Sibert 2013), but the slow and inconsistent rate of adoption within the sector shows that there is a misalignment between the BIM Utopia described by BIM Evangelists and the pragmatism required by practitioners who operate under tight time and budgetary constraints (Miettinen and Paavola 2014). If BIM is going to have the impact that

[1] tom.bartley@bristol.ac.uk

Bartley, T, McMahon, C and Denton, S (2016) Information Flows in Highway Project Delivery. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 739-748.

people desire of it, the technologies and processes underpinning BIM will need to align to the real world challenge of delivering projects (Arayici *et al*., 2009; Sackey *et al*., 2014). This is particularly the case during the adoption phase where new and old processes will be operating simultaneously within teams.

Like any information system (IS) intervention, BIM will require an element of process re-engineering (Alfred 2011) to unlock its maximum benefits. An early activity of process change is to map the current process (Kettinger *et al*., 1997) in order to develop the requirements for the change. IDEF0 has been proposed as a suitable modelling language for conceptually modelling IS requirements (Lee *et al*., 2007) as it presents a functional view of the system without the detail of specific data structures, organisational structures or temporal issues (Giaglis 2001).

APPROACH

In conducting this research we used a systems approach, which involved examining guidance documentation and formal requirements from clients, designers and contractors, conducting interviews with stakeholders from various organisation types and carrying out ethnographic-type reflections by the lead researcher being embedded in a project information management team over a 42 month period. We use this multi-method approach for data collection to understand what the formally defined processes are and to test how these are actually implemented in practice.

When we refer to "Highways" in this paper we refer to major roads (Motorways and A-roads), those which are designed to the Design Manual for Roads and Bridges (DMRB). Such roads are characterised by high volumes of traffic, mixed use of freight, commuter and distance travel, have few junctions or crossings and will typically have a speed limit of 50 mph (80 km/h) or higher (Walsh *et al*., 2011). There are approximately 50,000 km of such major roads in the UK (O'Flaherty and Hughes 2016). By "project" we refer to capital investment and major projects, where expenditure can run into tens or hundreds of millions of pounds sterling. We bound the research area to the UK as these projects operate under the same regulatory frameworks and so comparisons can be drawn across organisations. As the BIM mandate falls onto Highways England, the owner and operator of England's strategic road network, we focus on its processes. Highways England's standards are generally also applied on local authority schemes, though often with some adaptation.

Thus this research aims to contribute to understanding of the effective application of BIM for Highways projects, which is to identify what information is required to be managed, who creates what, who the recipients are and how the process is currently undertaken. Through this research, we do not intend to make any value judgements on productivity or efficiency or how things could be improved, but instead to describe real world processes undertaken by practitioners. This represents a key gap in the information management literature, particularly in infrastructure delivery, where the thrust of research on the implementation of BIM is aimed at keeping pace with the theoretical and proof of technology concepts, rather than understanding the particular mechanisms of the phenomenon under study. Throughout this research we look at highways projects as socio-technical systems. Projects involve people working in cross-organisational teams, socially constructed through contracts, branding and organisational business processes. The engineering process is highly dependent on information, material and mechanical technologies to design and construct the outputs of projects.

METHODS

The opportunity to conduct this research arose from a practitioner-researcher approach in which the lead researcher has been seconded into design and client organisations over a 42 month period. Throughout the period the researcher has taken an active role in projects and has collected field notes and relevant documentation for later analysis. These were supplemented by conducting semi- and un-structured interviews with key project stakeholders. Such qualitative methods allow a much richer understanding of the phenomenon under study (Harty 2008) and the semi-structured interview gives the interviewed the opportunity to explore in more detail, challenge statements and get under the skin of the issue (Easterby-Smith *et al* ., 2008). The interviews would each last approximately 60-90 minutes and the subject was asked to describe his or her job role in detail, sometimes this would relate to a specific project so that the descriptions were more tangible. The interviewer would then focus on the processes for specific parts. Data collection followed a grounded theory approach, collecting evidence across different data until the entire process was captured and validated.

Altogether, the research findings are based on three sources of data:

Published and unpublished materials from client, designer and contractor groups
11 semi-structured interviews with practitioners, which were transcribed:
1 x project director
3 x designer
5 x contractor
1 x client project manager
1 x lawyer
Observations and reflections by the lead researcher being embedded within project teams.

The interview transcripts and documentation were coded using a cloud-based Computer Aided Qualitative Data Analysis Software, dedoose.com, as a process to identify the factors involved in delivering highways projects and to highlight the information flows between different functions. No predetermined coding schema was used, as an inductive exercise, the aim was to develop a grounded model (Easterby-Smith *et al*., 2008, 175) whereby functions were identified and the interfaces between them were highlighted. Having a practitioner-research approach gave the analysis a richer semantic understanding to the underlying assumptions and meanings of statements.

This was developed into a narrative which discussed the various aspects of the process under study. Modelling using IDEF0 was used as an interpretive tool to provide a conceptual description of the narrative. Systems modelling, using diagrams with a known syntax and notation, provides an alternative means of describing a system than prose (Kassem *et al*., 2011). By displaying the characteristics of a system in this structured way stakeholders are better able to learn about and understand the topic under study and make more informed decisions about system and process change (Blockley and Godfrey 2000).

In order to model the information flows we are using Integration Definition for Function Modelling (IDEF0). IDEF0 is a systems engineering modelling notation which "is used to show data flow, system control, and the functional flow of life cycle processes." (US Department of Defense Systems Management College 2001, 51). By

modelling the functions and flows it is possible to develop a conceptual model describing the information flows in project delivery. An advantage of IDEF0 is that the flows do not necessarily denote chronological continuity or sequence in the processes, which means that functions can be iterative, concurrent or temporally separated. Similarly it does not assign a role or a specific means. This is complements the varied procurement and commercial arrangements of highways projects which could range from in house delivery, a full Design Build Finance Operate contract, or separate contracts let for each project stage.

This follows Yung *et al*., (2014) who used IDEF0 to model the process for MEP coordination with other designers' outputs through BIM and Kim and Jang (2002) who used IDEF0 to model the re-engineering the process television manufacture.

IDEF0 modelling

An IDEF0 model presents a top-down diagram where systems are defined in terms of functions. Within each function information is either created, consumed or modified.

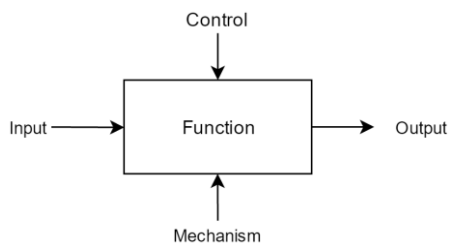


Figure 1: IDEF0 Syntax

Each function is symbolised by a box and then the Inputs, Controls, Outputs and Mechanisms (ICOM) are denoted by labelled arrows (see Figure 1). Inputs and outputs can link functions to represent flow. Each function can then be divided into sub functions and a new diagram produced to display a higher granularity.

For this exercise we are producing the highest level diagram, the "top level context diagram", which gives an overview of the high level and most important flows in the system. In this way we can identify the relationships between lifecycle phases, each of which fulfil a separate function, with the other functions on which the project depends. Based on a further qualitative analysis, using the narrative as the data for this stage, we have identified the following top level functions; Ongoing Asset Management, Scheme/Project Assurance, Survey, Scheme Identification, Design, Construction Planning, Construction, Handover, Supplier Management, Departures from Standards, External Stakeholder Management.

For each function we reviewed the narrative to identify the inputs, outputs, controls and mechanisms which relate to the function. Then using a diagramming software we started to build the diagram. First we drew each function separately and then started connecting the outputs of one with the inputs to the recipient functions. The inputs and outputs include a range of information types ranging from a go/no-go decision to a defined deliverable in the form of a report or drawing.

Results of the modelling exercise are shown in Figure 2, for presentation purposes we have condensed the final model. The following sections discuss the various elements of the model that the researchers feel pertinent by following the structure of the ICOM syntax.

Flows (inputs and outputs)

In order to interpret the model and understand what the flows represent, two key concepts should be understood.

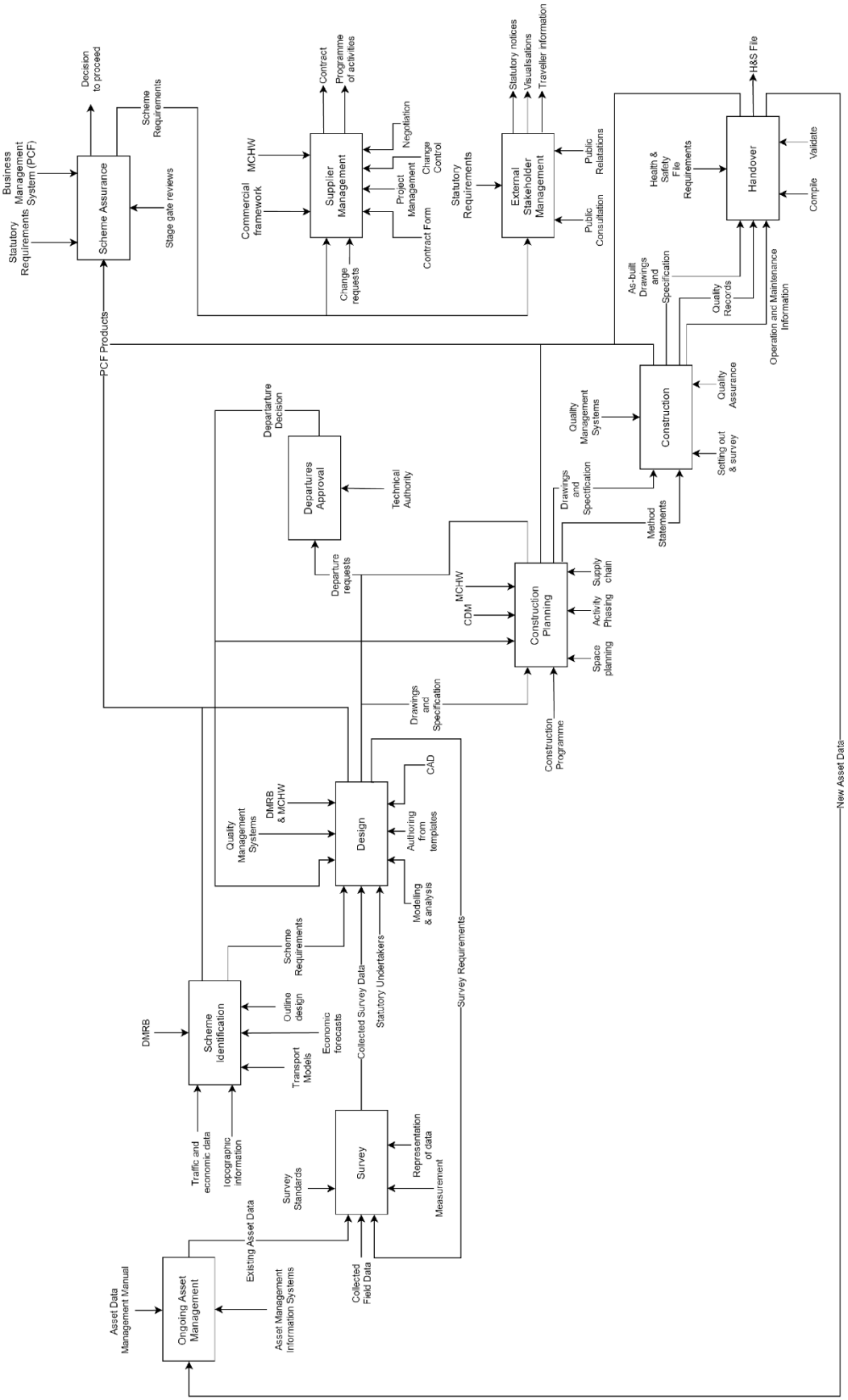


Figure 2: Context IDEF0 Model showing information flows across the highways project

- *Boundary Objects*

Boundary objects form the basis of collaboration in highway project delivery. The term "boundary object" was coined by Star and Greismann in (1989) and refers to documents and information artefacts which are transferred across functional or organisational boundaries as the basis of knowledge coordination (Whyte and Lobo 2010).

When we model the information flow we are modelling the transference of a boundary object to another function. We are not modelling the flow of materials or resources, the boundary object contains the information relating to those things. For instance a road scheme might require the placing of a man-hole. The man-hole and its associated activities exist in the real world, however not in the information system.

Data and documentation will inform the worker where to place it, what its specification will be and any method statements. The outputs are an as-built record and quality reports (Figure 3).

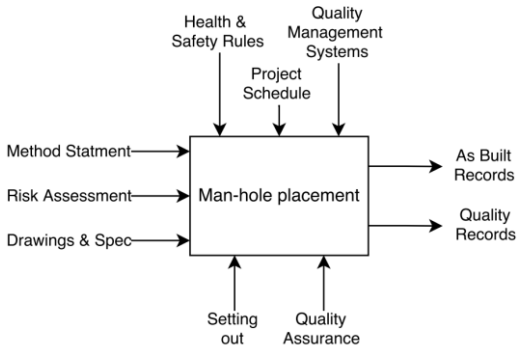


Figure 3: Example function demonstrating boundary objects

Such objects may be specific to an asset or activity, or be a report on a range of activities undertaken. For instance, Highways England's core deliverables (known as PCF products after the Project Control Framework project lifecycle) are created for the purpose of review, validation, approval and cross phase knowledge sharing. These are typically in the form of report, spreadsheet or drawing. Which may be shared in the native format, but are often converted to a stable PDF format so that it becomes a static record of the deliverable.

- *Document Management*

Document Management, though not represented in the model, is fundamental to how the flows are facilitated. We see in our data that a mix of formal and informal methods are used to share documentation and deliverables, both electronically and via paper. Procurement portals are common for supplier management prior to contract award and then the processes to be deployed during the project are agreed through negotiation.

BS 1192 (British Standards Institution 2007) is a core requirement of BIM Level 2, but and highways practitioners are struggling to accommodate it in their processes through deploying cross-organisational Electronic Document Management Systems (EDMS). However, at present, the multitude and haphazard deployment of these systems cause almost as much confusion as the problem they are supposed to solve.

The emergence of tablet and mobile computing has made electronic documentation more attractive, because they can be brought into the field and used for data collection as well as document display. It is good practice for suppliers to keep an archive of all project information for at least as long as the warranty stated in the contract, especially records relating to the quality management, sometimes referred to as an audit trail, of the activities undertaken and information produced. If there are incidents which require the project to enter arbitration or litigation, this archive provides the bulk of evidence.

Functions

The model broadly groups the functions into four categories.

- *Ongoing network and asset management*

Interview subjects were all keenly aware that a highway project is only part of the asset lifecycle. Few highway projects are building a road on green-field, many are, instead, major modification of an existing road and in all cases a project will connect with the existing network. The notion of "taking possession" of a road during projects and then handing back to the asset operator and maintainer, often also an outsourced role, was often articulated. The transfer of the as-built information to the operator is through the Health and Safety file, which should contain all information to support the safe operation of the asset.

- *Existing condition data*

The conceptual design (part of option selection), detailed design and construction planning all rely heavily on gathering data about the world and structuring it to support decision making. The first port of call is to look at data which is already available from the operator's asset management systems, topographic and mapping suppliers such as Ordnance Survey and the British Geological Survey and to look to economic data to model traffic growth. Once a corridor and site boundary has been identified further investigative and measured surveys can be undertaken.

Such surveys can are expensive, placing workers in potentially unsafe environments and causing inconvenience to road users, therefore they are only undertaken when absolutely required. A lack of robust survey and existing conditions data requires engineers to make assumptions through interpolation or referring to experience. Many argue that much survey work, aside from that to assess condition and deterioration, could be avoided if sufficient record keeping from previous interventions had been maintained.

- *Project Lifecycle*

Similar to all engineering environments, highway projects follow a lifecycle which includes stage-gate reviews and governance. Highways England's project lifecycle is defined through the Project Control Framework (PCF), which has eight stages: Strategy, Shaping and Prioritisation, Option Identification, Option Selection, Preliminary Design, Statutory Procedures and Powers, Construction Preparation, Construction, Commissioning and Handover, Closeout. There is a second version of the PCF, called the Single-Option PCF, which is for projects which will not have an option selection phase. The Single-Option PCF includes stages 0, 3, 5, 6 and 7.

At the end of each stage the supplier is required to produce a number of deliverables, documenting the activities undertaken. These deliverables are then used during stage gate reviews for assurance and as the basis for activity in the next stage. At Highways England deliverables are called PCF Products, at each stage there are up to 129 products in 23 categories, each could contain one or many documents. Local authorities operate a similar set of stage gates, but are not as prescriptive as to the information deliverables for each stage. We have, therefore, taken an abstraction of the PCF to group the activities as described through the functions they fulfil. These functions follow a diagonal spine through the model and relate to the technical delivery of projects.

- *Project Management and Assurance*

Aside from the technical delivery of projects there are a number of functions which run concurrently supporting the technical assurance and smooth running of the project. These include operating a stage review process, stakeholder management, giving permission to depart from standards, managing supply chains and project schedules.

These functions are often, though not always, undertaken by the client. For instance, contractors will often employ the designer to validate that what has been built meets the design, demonstrating that the work has been done to ensure the project will meet its objectives.

The information flowing through these functions are generally reports on activities, instructions and contractually related documentation.

Controls and Mechanisms

- *Standards*

The highways sector is beholden to standards, they provide the generic requirements of all highway project delivery and are relied up extensively by all stakeholders. The Design Manual for Roads and Bridges (DMRB) and Management Contracts for Highways Works (MCHW) are developed by Highways England and used extensively on local authority schemes. Both the DMRB and MCHW also signpost a great many other standards to which designs, processes and products must conform.

The DMRB, effectively, provides the template to which the ideal highway will be designed. Text contained within a black box is mandatory and must be followed. All other text is advice and guidance. There are a number of circumstances where it is acceptable not to conform to mandatory requirements, such as geometric constraints, economy, or conflicting requirements. In this case the project will need to seek permission for a Departure from Standard from the client's technical authority.

- *Contracts and specifications*

Typically all but the highest levels of project management and assurance are outsourced for the delivery of highway projects. The management of suppliers is through the use of contracts, which detail the work that the supplier will carry out, the requirements for quality and processes and the payment terms. Sub-contracts will typically mirror the main contract, apportioning packages to lower tiers of the supply chain. It is very rare that there are no changes to the contract after it has been signed. Any changes or negotiations must follow a strict change control process, which includes storing correspondence such as emails, meeting minutes and change notices. This is sometimes handled by an EDMS.

DISCUSSION

Highway projects principally deal concurrently with two types of information. Technical information relating to the configuration and implementation of the project and management information supporting technical assurance and stakeholder management. At current this is predominantly a paper based system (albeit functioning electronically), which is engrained through templates and requirements of standards, frameworks and contracts. There are attempts to automate and formalise document management through EDMS, but the research showed that this has yet to become engrained.

The role of standards cannot be understated. Project participants are accustomed to navigating great quantities of technical requirements, and much of the engineer's job is

to signpost the relevant clause, rather than design from first principles. Departures from standard are common and are the principle technical information flow between the client and supplier in between project stage gates. Interview subjects often raised the importance of getting a high quality existing condition survey early. Such information supports the design and planning of many aspects of projects.

CONCLUSION

In this paper, following qualitative analysis, we have described the information flows in prose and through the development of an IDEF0 model. The research came from the need to understand the current uses and flows of information on projects and, in future work, compare this to the requirements of BIM Level 2. Many argue that BIM Level 2 requires process re-engineering (Arayici *et al*., 2011; Mom *et al*., 2014; Sebastian 2011). The first stage of re-engineering is to understand how the system is currently configured, which is the contribution this paper makes.

REFERENCES

Alfred, O (2011) Modelling organizations' structural adjustment to BIM adoption: A pilot study on estimating organizations. *Journal of Information Technology in Construction*, **16**(Special Issue), 653-668.

Arayici, Y, Coates, P, Koskela, L, Kagioglou, M, Usher, C, and O'Reilly, K (2011) BIM adoption and implementation for architectural practices. *Structural Survey* **29**(1), 7-25.

Arayici, Y, Coates, P, Koskela, L, Kagioglou, M, Usher, C and Reilly, K O (2009) Technology adoption in the BIM implementation for lean architectural practice. *Automation in Construction*, **20**(2), 189-195.

Blockley, D and Godfrey, P (2000) *Doing It Differently: Systems for Rethinking Construction*. London: Thomas Telford Ltd.

British Standards Institution (2007) BS 1192: *Collaborative Production of Architectural, Engineering and Construction Information: Code of Practice*. London: British Standards Insitution.

Easterby-Smith, M, Thorpe, R, and Jackson, P and Paul R (2008) *Management Research*. London: Sage Publications.

Giaglis, G (2001) A taxonomy of business process modeling and information systems modeling techniques. *Journal of Flexible Manufacturing Systems*, 13(2), 209-228.

Harty, C (2008) Sociology and construction management research: Issues, approaches and implications. *In*: A Dainty (Ed.) *Proceedings 24th Annual ARCOM Conference*, 1-3 September 2008, Cardiff, UK. Association of Researchers in Construction Management, Vol. 2, 697–706.

Kassem, M, Dawood, N and Mitchell, D (2011) A structured methodology for enterprise modeling: A case study for modeling the operation of a british organization. *Journal of Information Technology in Construction*, **16**, 381-410.

Kettinger, W J, Teng, J T C, and Guha, S (1997) Business process change: A study of methodologies, techniques, and tools. *MIS Quarterly*, **21**(1), 55-80.

Lee, G, Eastman, C M, and Sacks, R (2007) Eliciting information for product modeling using process modeling. *Data & Knowledge Engineering*, **62**(2), 292-307.

Mawlana, M, Vahdatikhaki, F, Doriani, A and Hammad, A (2015) Integrating 4D modeling and discrete event simulation for phasing evaluation of elevated urban highway reconstruction projects. *Automation in Construction*, **60**, 25-38.

Miettinen, R, and Paavola, S (2014) Beyond the BIM utopia: Approaches to the development and implementation of building information modeling. *Automation in Construction*, **43**, 84-91.

Mom, M, Tsai, M.-H, and Hsieh S.-H (2014) Developing critical success factors for the assessment of BIM technology adoption: Part II Analysis and results. *Journal of the Chinese Institute of Engineers*, 37(7), 859-868.

O'Flaherty, C A, and Hughes, D (2016) *Highways: The Location, Design, Construction and Maintenance of Road Pavements 5th Edition*. London: ICE Publishing.

Sackey, E, Tuuli, M and Dainty, A (2014) Sociotechnical systems approach to BIM implementation in a multidisciplinary construction context. *Journal of Management in Engineering*, **31**(1).

Sebastian, R (2011) Changing roles of the clients, architects and contractors through BIM. *Engineering, Construction and Architectural Management*, 18(2), 176-187.

Sibert, B (2013) Using building information modelling on a highway project. *Civil Engineering*, 166(1), 9.

Star, S L and Griesemer, J R (1989) Institutional ecology: 'Translations' and boundary objects(amateurs and professionals in Berkeley's Museum of Vertebrate Zoology 1907-39. *Social Studies of Science*, **19**(3), 387-420.

US Department of Defense Systems Management College (2001) *Systems Engineering Fundamentals*. Fort Belvoir, Virginia: Defense Acquisition University Press.

Walsh, I D, Hunter, R N, Darrall, L, Matthews, P, Jameson, P and Thorp, J (2011) ICE manual of highway design and management. London: Thomas Telford Ltd.

Whyte, J and Lobo, S (2010) Coordination and control in project-based work: Digital objects and infrastructures for delivery. *Construction Management and Economics*, **28**(6), 557-567.

PRACTICES AND PRACTICE-BASED PERSPECTIVES

SITE PRACTICE: THE ROLE OF DESIGN DRAWINGS WITHIN SOCIAL COMMUNITIES

Haseebullah Wahedi[1]

Department of Building Technology and Management, Danish Building Research Institute/Aalborg University, Copenhagen, A. C. Meyers Vænge 15, 2450 København, Denmark

The role of drawings within design in the construction projects and production has long been in focus, though only limited studies have been conducted which focused on the role of design drawings in construction phase. The purpose of this study was to elucidate the role of design drawings within different practices in the construction phase. The research is based on an ethnographic study of a case in Denmark. The empirical data were collected through direct observations and semi-structured interviews with site managers, contract managers, foremen and craftsmen. Findings revealed that the construction phase comprises several communities and practices, leading to various uses of the drawings. The results indicated that the craftsmen used drawings to position themselves in the correct location, and that the site managers and contract managers used them as management tools and legal documents. It is concluded that the drawings and the physical building play a vital role in relation to coordination within and across the various communities that are in play within the construction phase.

Keywords: drawings, boundary objects, craftsmen, social communities, site practice

INTRODUCTION

Basically the construction phases can be categorised in (1) the design phase where the drawings are produced and processed and (2) the construction phase where the information in the drawings is interpreted to the physical building. However, it must be emphasised that several social communities, working contexts and practices exist within the construction phase. Thus the drawings have various functions within these practices, and are utilised for various purposes. In this study, the construction phase is unfolded and focus is on the four primary communities (site managers, contract managers, foremen and craftsmen) that are in play on a construction site. The study is based on an ethnographic study of four communities that are related to a construction project in Denmark. The purpose of this study was to elucidate the role of design drawings within the different practices in the construction phase. It is elucidated how the information contained in the drawings are interpreted and translated to the physical building. The study sheds light on how the different contexts affect the individual's perceptions and use of drawings. The study intends to bring about a better understanding of the practices that take place on a construction site and to contribute to knowledge about the various communities that are in play.

[1] haw@sbi.aau.dk

Wahedi, H (2016) Site Practice: The Role of Design Drawings within Social Communities. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 751-760.

THEORY

Many studies have been conducted which have concerned themselves with how different communities emerge and act within organisations and how knowledge and information sharing takes place within these communities. Lave and Wenger (1991) coined the term Communities of Practice (CoP), which is defined as "Communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly" (Wenger 2011, 1). According to Wenger (2011) CoP have existed for many years, and is shaped by the people who engage in collective learning processes. Wenger (2011) defines three characteristics that are essential for establishing a community as CoP, (1) The domain, where members engage and work toward a common goal, (2) The community, where members interact and engage in joint activities, discussions, share information, and build a relationships that enable them to learn from each other, (3) The practice, since members of the community are practitioners who have developed a repertoire of resources; experiences, stories, tools, in other words shared practice (Ibid 2011). Members of the CoP have worked together for several years and have built and maintained a mutual understanding (Ruikar et al., 2008). The different CoP and other communities are separated by professional and social boundaries and peripheries - overlap between two or more boundaries - (Gustavsson and Gohary 2012). Boundary objects enable continuity between these boundaries (Ibid. 2012), and therefore play a vital role.

The notion of boundary object was developed by Star and Griesemer (1989). During the study of Berkeley's Museum of Vertebrate Zoology, 1907-39, Star and Griesemer (1989) used boundary objects to study the interaction between the different knowledge cultures, working toward a common goal, where information is transferred from one practice to the next (Ibid. 1989). They define boundary objects as “Boundary objects are objects which are both plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites. They are weakly structured in common use, and become strongly structured in individual-site use. They may be abstract or concrete” (Ibid. 1989: 393). They emphasise that knowledge is embedded in the practice, i.e. in the tools, procedures, work cultures and technologies that are in play within a certain social world. Thus the boundary objects play a vital role in coordination of information across these practices (Ibid, 1989).

Throughout the last century, many studies were conducted where the functionality and role of design drawings as boundary objects within design and production were examined and elucidated. In general the literature presented here is concerned with three fields. The first part of the literature is represented by Cahill (2000; 2002) and Style (1986). Cahill (2000; 2002) emphasised the role of drawings as primary sources of information, and focused on how this role has changed over the time. Style (1986) underlines three classes of information that are essential for understanding the design intention of the drawings, i.e. (a) what should be performed? (b) Where should it be located? And (c) how should it be placed in relation to other components? Hence design drawings specify spatiality and the information about the components to be installed (Cahill 2002) and (Style 1986).

The second part of the literature focuses on the role and functionality of the drawings in the design phase, as it is emphasised that the drawings as boundary objects are able to transfer information between various practices. Henderson (1991) examined the

role of drawings as visual representations, and whether they act as boundary objects within and across practices in the design phase. She underlined that drawings serve as 'social glue' between various individuals and groups. According to Henderson drawings play a central role in design meetings as "coordination and conflict take place over, on, and through the drawings" (Henderson 1991, 449).

The third part of the literature is concerned with the role of drawings as boundary objects across the design and production communities. Carlile (2002) conducted a study of sales/marketing, design engineering, manufacturing engineering, and production in a product development context. He emphasises that knowledge is embedded in practices and in the technologies, methods and rules of thumb that are in play within different communities, and may therefore be hard to transfer or explicate. Carlile (2002) underlines that models, objects and maps are the most efficient boundary objects and the only categories of boundary objects that support transformation of knowledge.

The majority of the studies focus on the role of drawings in the design phase (in construction projects) and manufacturing/production (outside construction projects). The literature mainly concerns the role of drawings in a production context where the focus has been on product development and other concepts. However this study focuses on shedding light on the role of design drawings within and across CoP and other social communities in a construction context.

METHOD

The present investigation is a part of a PhD study and is based on the initial empirical data collection. The paper is based on an ethnographic study of a case in Denmark, where TN contractor (pseudonym) was design-and-build contractor. The construction firm did not have its own craftsmen; hence it was dependent on various subcontractors, selected by tender and each with a different professional expertise. Thus the temporary organisation is characterised by diversity in professional contexts and practices. Drawings and other project-related documents are exchanged via ‘byggeweb’, a Danish web-based digital tendering portal.

Methodological approach

I conducted a four week ethnographic study of the construction project, where I spent 6-8 hours a day, 5 days a week on the site. The empirical data were collected mainly through direct observations (Spradley 1980) and ethnographic interviews (Spradley 1979). Reviewing meeting minutes were likewise a part of the empirical data collection. Additionally I tape-recorded the meetings and the workshops. During the first week, the empirical data collection comprised general observations of the ongoing activities on the construction site. The observations gave me insight into the contractor's working practices and working contexts. I noticed that four different communities were at play on the construction site: (1) site managers, (2) contract managers, (3) foremen, and (4) craftsmen.

These communities worked in different contexts and had different roles and responsibilities. In order to gain insight into their work practices and day-to-day work, I chose to observe these communities in their working contexts. I observed the site managers during the construction meetings and during a work day in the site hut and on the construction site. I observed the contract managers during the construction meetings. I observed the foremen and the craftsmen on the construction site, and chose to follow five different subcontractors, a day each, during their working hours

on the site. To observe and follow the subcontractors from early in the morning and to the end of the working day provided me with an insight into their working contexts, the problems they encountered and how they handled these situations. I asked questions during the observations. I interviewed them in the context that they were in. The advantage of conducting interviews with the craftsmen on the site was that they did not have to leave the construction site, so they could still follow the ongoing activities. The disadvantage is that they could easily be distracted by the activities that occurred, and noise that affected the sound quality, which proved to be a challenge during the transcription process. The interview questions were sent to the contract managers via e-mails. Interviews with site managers took place in the site hut, where they spent most of the time.

ANALYSIS

The following sections focus on two types of drawings: floor plans and trade-specific assembly drawings. To understand the role of drawings on this site, I draw on the three concepts (i.e. domain, community and practice), and further unfold the four communities by looking at the factors that are important for understanding the role of drawings. Hence the four communities are analysed on the basis of their (1) contexts, (2) professional backgrounds, (3) responsibilities, (4) technologies and tools, and (5) utilisation of drawings (see Table 1).

Community of practice: Site managers

Site managers are engineers or constructors, and may also have a background as artisans. Four site managers are associated with the project whose overall responsibility on site is the management and coordination of the construction process (control of process, time and budget as well as contractual matters). Concurrently they perform other duties such as procurement, organisation of the construction meetings, safety coordination at the construction site, and contact with consultants, municipality and other authorities. They are provided with technologies such as printer, laptops, iPads and mobile phones. Each manager has floor and layout drawings that are displayed at the office. The physical drawings are organised in binders. They receive and share drawings and other documents through ‘byggeweb’, a Danish web-based digital tendering portal.

Site managers need to coordinate the process and therefore organise several internal (site managers) and external (the various gangs) meetings during the week. During the internal meetings the discussions take place over the drawings since the drawings are used to coordinate the work. During planning meetings they use both the physical drawings that site managers bring to the meetings, and digital drawings displayed on a projector, and interchange information to update each other. Although formal meetings are organised where discrepancies, conflicts and challenges are discussed, a significant information sharing takes place during the breaks, and other informal conversations.

They organise external meetings with the various trade contractors in order to coordinate and plan future work. Each community has various interests in the meetings: site managers are interested in a continuous process, foremen are interested in obtaining a schedule, while craftsmen's interest lies in having information about where and when to start. During the meetings, the floor and layout drawings are both used to point at and to mark certain locations, and as planning and coordination tools, since new plans are devised on the basis of the drawings. Nonetheless drawings

become legal documents when disagreements and discrepancies occur between site managers and other communities (e.g. consultants). Hence the various versions are filed and used as evidence.

Site managers are members of a CoP on the site as they act within a joint professional domain, where they interact with each other, help and support each other and discuss challenges occurring on the site in order to find solutions.

Social community: Contract managers

Contract managers are engineers or constructors, and may have a practical artisan background. Each trade contract has one contract manager who is responsible for managing the trade contract and the gang on site. He usually runs several concurrent projects. His responsibilities are allocation of resources (e.g. manpower, materials and equipment) to the various projects, providing drawings to the construction sites, obtaining tenders from suppliers, contractual matters and participation in construction meetings. Contract managers primarily use iPads and mobiles on site. In addition, they use physical drawings during construction meetings.

Contract managers' professional background is similar to those of site managers. The factor that distinguishes their roles is their working context, as the contract managers only have the responsibility for their sub-contracts and the gang on site. In case the drawings do not contain required information, it is their responsibility to provide the gang with the information. Given that they are only responsible for their own contract processes, they do not visit the site as frequently; foremen are therefore their pivotal link to the site. In spite of being responsible for the gang on site, they participate as independent entities and communities during site meetings. They are not members of a CoP on the site, but function as members of the CoP acting outside the site, i.e. within their organisations. They share knowledge and information with their colleagues in the organisation, seek experience, and discuss and find solutions together with them.

Drawings are used as management tools and legal documents, e.g. if there are conflicts, discrepancies or disputes between contract managers and site managers or between contract managers and consultants.

Social community: Foremen

Foremen have practical artisan background, supplemented with professional courses that make them thoroughly versed in process management tools. A gang usually has one or two foremen (depending on the size and organisation of the gang) who are primarily responsible for the organisation of construction work on the site. Concurrently they are responsible for piecework, materials procurement, resource allocation (e.g. manpower, materials and equipment) on the construction site and organisation of foremen meetings in order to pass on drawings and other crucial information to the gang. Most of the foremen are provided with iPads and mobiles, which are used to shown the drawings. The main tools used in this context are drawings and artisan tools such as ruler, hammer, pencil (e.g. carpenter pencil, concrete pencil), working knife, drills, screws and lifting tools (e.g. crane and lift). They have no access to ‘byggeweb’, hence the drawings are sent to them by their contract managers via e-mail, or local file sharing systems. They are practitioners and build the physical building; however this role is hampered by administrative tasks (e.g. piecework, wages and materials procurement).

Foremen are the only community on site who inhabit more than one social world. They are primarily craftsmen, but have been recruited to carry out the role of foremen, which implies that they step into a new position, where they serve as a liaison between, on the one hand, gang and site managers (site), and on the other hand, gang and contract manager (firm). They play both roles simultaneously, and must ensure that needs and interests of both communities are met. In spite of their role as craftsmen, they are not members of the same domain in which the craftsmen act, as they still retain their position as foremen among the gang. They can shift from the role of craftsmen to the role of foremen, and vice versa.

One of the objects that allows shifting between the roles is the drawing which in this context is used as management tool and to build the physical building. As a management tool, the information (e.g., quantities, dimensions and locations) is used to devise delivery schedules, and to calculate the time consumption. To build the physical building they need temporal and spatial information in order to position themselves in the building.

Foremen are not members of a CoP, but act as individual social communities. During planning meetings, they contribute with construction knowledge that enables construction managers to devise schedules and coordinate work. They inform and update contract managers in relation to the construction process, as contract managers are not on the site as frequently. Likewise they are a pivotal link between the gang and site managers since the gang contacts foremen if drawings are inadequate, or if there are challenges on the site which requires action from site managers. Thus foremen play a pivotal role in enabling communication across the three communities.

Community of practice: Craftsmen

Craftsmen usually have professional training (e.g., bricklayer, carpenter, plumber, or electrician). They go through an apprenticeship, where they become thoroughly versed in the construction materials and artisan tools. The main tools utilised within this community are drawings, ruler, hammer, pencil (e.g. carpenter pencil, concrete pencil), working knife, drills, screws and lifting tools (e.g. crane and lift).

Craftsmen involved in a gang have fixed roles and perform different tasks at the construction site. For instance, a gang consisting of 10 men will be divided into small groups (usually 2-3 men) who are assigned different tasks. Most of the craftsmen work in permanent teams that are moved from project to another. The craftsmen, who have worked together for many years, know each other's professional and personal boundaries and have built a mutual understanding. The team is therefore a pivotal focal point in relation to information sharing on the site. If they bump into unknown challenges, they will try out a solution by using their tools and draw on their knowledge and experience. They discuss the possibilities and limitations of the physical building and their tools in order to address the situation. The craftsmen use the breaks and informal meetings to coordinate the work and tell stories about challenges that they encountered during the day. The informal conversations therefore play an important role in relation to coordinating and updating the gang.

But in order to start and carry out their work they must place themselves at the correct location in the building. Therefore, they use the information in drawings (e.g. elevations, dimensions and locations), to position themselves in the building and in association with other components. The assembly drawings are used to understand the details about how the components should be assembled, whereas floor plans provide spatial information. When they start on a new location, they place themselves

on the location and hold the drawing in their hands to see whether there are discrepancies between the design drawing and the physical environments. Subsequently, they will put the drawing on a horizontal surface in order to see where to start. In order to remember the dimensions and elevations, they write the numbers up on the walls or other components. Once they have gained insight into how the work is done and where to place themselves in the building, they put the drawing aside (typically in a wheelbarrow, along with other tools). The drawing will not be used again until they start on a new location or encounter a challenge (e.g. collision with other components). In case of collision with other components, each gang will consult their own drawings, as they do not have the professional prerequisites to understand the trade-specific information that the other drawings contain. In this specific situation, the physical building plays a vital role because the building comprises various professional boundaries and therefore enables coordination across these boundaries.

To carry out the work, the craftsmen need information about (a) when work is initiated, (b) where on site it must be performed, and (c) how it should be performed (e.g. in relation to other components). Drawings coordinate their work by providing information about (b) where the work is performed and (c) how it is performed in relation to other components, while schedules - devised from drawings - provide information about (a) when work must be commenced. The role of the physical building as coordinating object is enhanced (e.g. when drawing is inadequate) as it provides information about (c) how the work is performed in relation to other components. For instance, a plumber disregards the drawing if it shows his pipes to be installed in the same elevation as vents. In this case the physical building enables coordination across these two communities that work on a shared location on site.

Table 1: The role of drawings within the four communities and practices.

	Site Managers	Contract Managers	Foremen	Craftsmen
- Context	Site hut	Office/site	Site hut/site	Site
- Professional background	Constructor	Constructor	Artisan training	Artisan training
	Engineer	Engineer	Additional courses	Apprenticeship
- Responsibility on site	Site/process management	Trade contract	Task coordination	Carry out the construction work
	Procurement	Resource allocation	Piecework	
- Tools and technology	iPad	iPad	(iPad)	Construction tools
	Computer	Mobile phone	Tools	Drawing
- Utilising design drawings	Drawing	Drawing	Drawing	
	From drawing to plan	From drawing to plan	From drawing to plan /physical building	From drawing to physical building
	Legal documents/filed	Legal documents/filed	Filed	Put aside/ Disregarded

Craftsmen are members of various CoP. They act within joint professional domains and communities, and work toward a common goal. Members of various CoP have the same professional background that distinguishes them from other communities.

DISCUSSIONS

Site managers play an administrative role at the site, and act in a common domain. They organise formal and informal meetings where they update each other, share

information, discuss various options, find solutions and coordinate future work. They constitute a community of practice on the site where they work within their own professional and social boundaries, and work toward a common goal. They use drawings as management tools (e.g. devise schedules) and legal documents.

The various contract managers do not share a domain of interest (Wenger 2011) on the site, but have some common characteristics which enable them to interpret and use drawings in the same way on the site. They act as individuals since they are not part of a domain in which they can exchange information and have a common goal: they constitute an independent social community. However contract managers are members of a community of practice, acting outside physical environment of the site. Within this community the drawings play a role as management tools and legal documents.

Like contract managers, they have some common characteristics that enable them to interpret and use drawings in the same way on the site. Foremen are not members of a CoP on the site, but can bring information across the communities. They play a vital role on the site because they are a link between the three communities, and transfer information across the boundaries. They are a vital link between the gang and site managers and between the gang and contract manager. On the site, they play both the role of craftsmen and foremen: they draw on their artisan practices to carry out the work and put their administrative skills into play in order to solve managerial challenges. They use drawings as both management tools and to build the physical building.

On the contrary, the craftsmen are practitioners and act within a shared domain. They are members of well-established CoP on site, and act within a common professional and social domain, where they have shared practice and work toward a common goal. The small teams interact with each other on a daily basis. During breaks and informal conversations they coordinate work, and tell stories about the challenges that they encountered during the day, and how they were solved. They interpret information in drawings and put their professional knowledge into play to build. Once they have gained insight into what to build, how to build and where to build (Style 1986), they put the drawing aside and commence the work. If the drawing is inadequate they will disregard the drawing and use the physical building in order to coordinate the work with the other gang. They only need the information in drawings in order to build, once they have gained insight, they will disregard the drawings and will not file them as site managers and contract managers do.

The analysis indicates that the four communities act within their professional and social boundaries, which implies the need for objects that can enable coordination across these boundaries. Hence the drawings and the physical building play a vital role as boundary objects since they enable coordination within, and across the boundaries. Drawings enable coordination between site managers and craftsmen, as site managers use drawings to devise schedules that form the basis for the work that the craftsmen must perform. Additionally, drawings are the basis for contract between site managers and the various trade contracts, and can be used as legal documents.

On the contrary, the role of drawings as coordination tool, within and across the various gangs, is weakened, since they also use the physical building to coordinate the work. The physical building forms the common basis for all craftsmen as they will be working on a common location. Although craftsmen are looking at their own drawings, they point at the physical building in order to coordinate the work. In this

case the drawings are disregarded. Likewise the physical building plays a pivotal role as a coordinating object during the meetings. Although the participants are looking at a drawing, they use the building (e.g., a staircase, main entrance, large hall etc.) as a point of departure and navigate through the building from that point, in order to coordinate the work.

During joint meetings the site managers use layout drawings to coordinate work with the various gangs. They come to the drawings, pointing to them and marking certain areas that are to be discussed during the meetings. However the study indicates that some drawings do not enable coordination across the boundaries, but are used solely within the boundaries of various communities. For instance the trade-specific assembly drawings enable coordination within the boundaries of each subcontractor (i.e. across contract managers, foremen and craftsmen, who are connected with the same trade), and across the boundaries of site managers and the specific subcontractor.

Floor and layout drawings involve several professional boundaries, whereas trade-specific assembly drawings are rarely used during joint meetings. Hence some assembly drawings function as silos across the subcontractors because they are highly trade-specific, and do not enable coordination across these boundaries. However some floor drawings contain trade-specific codes and symbols, which can entail that they do not enable coordination across professional boundaries. In this case the physical building plays a crucial role, as a coordination tool, across the boundaries.

CONCLUSIONS

The analysis revealed that the construction site comprises several divergent communities, each with different contexts and practices. Hence the roles of drawings within these communities are varying and ambiguous, since they are utilised for various purposes.

The study indicates that drawings play a pivotal role in enabling coordination, both within but also across various boundaries. Layout drawings serve as boundary objects across the boundaries, whereas trade-specific drawings do not enable coordination across the boundaries. However the physical building plays a crucial role as boundary object, since it can transfer information within and across the social communities and the communities of practice. Furthermore the study shows that drawings play a vital role within the different communities as drawings are used to devise new plans (e.g. schedules), and play roles as management and coordination tools, legal documents, and representation of design information.

Apparently, there are two well-established communities of practice in construction projects; (1) site managers, and (2) craftsmen. Furthermore the study shows that there are two loose social communities; (a) contract managers, who have an administrative role, and (b) foremen who are an important coordinating factor, playing a role as an information carrier across the three communities.

Given that the present study was based on a construction project in Denmark, a design and build contract, the results cannot be generalised. However the study provides insight into site practice and the role of drawings within the various communities in the construction phase.

REFERENCES

Cahill, D (2000) *Utilising Information in Architectural Design Drawings*, PhD Thesis, Edinburgh: Heriot-Watt University.

Cahill, D A (2002) Utilising information in architectural design drawings: Problems and solutions. *Edinburgh Architecture Research*, **28**, 46-65.

Carlile, P R (2002) A pragmatic view of knowledge and boundaries: Boundary objects in new product development. *Organisation Science*, **13**(4), 442-455.

Henderson, K (1991) Flexible sketches and inflexible data bases: Visual communication, conscription devices, and boundary objects in design engineering. *Science, Technology, and Human Values*, **16**(4), 448-473.

Lave, J, and Wenger, E (1991) *Situated Learning: Legitimate Peripheral Participation*. Cambridge: Cambridge University Press.

Spradley, J P (1979) *The Ethnographic Interview*. New York: Holt, Rinehart and Winston.

Spradley, J P (1980) *Participant Observation*. New York: Holt, Rinehart and Winston.

Ruikar, K, Koskela, L and Sexton, M (2009) Communities of practice in construction case study organisations: Questions and insights. *Construction Innovation*, **9**(4), 434-448.

Star, S, and Griesemer, J (1989) Institutional ecology, 'translations' and boundary objects: Amateurs and professionals in Berkeley's museum of vertebrate zoology 1907-39. *Social Studies of Science*, **19**(3), 387-420.

Styles, K (1986) *Working Drawings Handbook 2nd Edition*. Oxford: Architectural Press.

Tina, K G and Gohary, H (2012) Boundary action in construction projects: New collaborative project practices. *International Journal of Managing Projects in Business*, **5**(3), 364-376.

Wenger, E (2011) *Communities of Practice: A Brief Introduction*. Available from http://hdl.handle.net/1794/11736 [Accessed June 2016].

(RE)CONSTRUCTING THE WICKED PROBLEM THROUGH THE VISUAL AND THE VERBAL: THE CASE OF A DIALOGUE BASED ARCHITECTURAL COMPETITION

Peter Holm Jacobsen[1], Chris Harty[2] and Kjell Tryggestad[3]

[1] *Department of Organization, Copenhagen Business School, Solbjerg Plads 3, DK-2000 Frederiksberg, Denmark*

[2] *School of Construction Management and Engineering, Whiteknights, P O Box 225, Reading, Berkshire, RG6 6AY, UK*

[3] *Copenhagen Business School/Hedmark University College, Lærerskolealleen 1, 2418 Elverum, Norway*

Wicked problems are open ended and complex societal problems. There is a lack of empirical research into the dynamics and mechanisms that (re) construct problems to become wicked. This paper builds on an ethnographic study of a dialogue-based architect competition to do just that. The competition studied had the purpose of selecting a design, a project and a design team for a large multifunctional building in Copenhagen. As a part of the competition, four different architect-teams had to come up with solutions on how to transform an old brewery site into a multifunctional building. During the competition, the invited architectural teams presented their designs and team organization in three parallel workshops for a panel of client advisors, user representatives as well as a professional jury board. Our data consists of semi-structured interviews with key informants before, during and after the competition and participant observations from all the workshops. We focus on the dynamic interplay between design visualizations and verbal dialogues and the ways in which contradictions and tensions emerge and play out. When the architect teams present their solutions at the workshops, the visualization processes creates new knowledge and insights, but at the same time present new problems related to the ongoing verbal feedback. The design problem being (re) constructed appears as Heracles' fight with Hydra: Every time Heracles cut of a head, two new heads grow back. The paper contributes to understanding the relationship between the visual and the verbal (dialogue) in complex design processes in the early phases of large construction projects, and how the dynamic interplay between the design visualization and verbal dialogue develops before the competition produces, or negotiates, “a "winning design”.

Keywords: architectural competition, design visualizations, wicked problems

INTRODUCTION

Architectural competitions are used in the early design phases to visualize alternative aesthetics and functionality of building and construction projects. How the building is visualized and how the selection process is organized is different from project to project. In this paper we present and analyse a new form of architectural competition

[1] phj.ioa@cbs.dk

Jacobsen, P H, Harty, C and Tryggestad, K (2016) (Re)Constructing the Wicked Problem through the Visual and the Verbal: The Case of a Dialogue Based Architectural Competition. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 761-770.

organized to select a design *and* an architect-team for a large building project. We understand architectural competitions as social technologies used by clients to visualize different possible solutions to a design problem (Kreiner, 2010). We contribute with a practice-based analysis of a new form of dialogue-based competition within the Danish construction industry. In the last decade a number of new forms of competition procedures have been used by client organizations in Denmark (Georg, 2015; Kreiner, 2010; Kreiner, 2012; Kreiner *et al*., 2011). The use of dialogues between the architects, the client organization and the jury board as a part of architectural competitions is not unproblematic, because new concerns emerge in practice and the organizers of the competition have to balance justice, efficiency and creativity in new ways (Kreiner, 2010). In a more general sense, the dialogue-based competition also points to the significance of the relation between the client and the design team. Empirical studies from the Netherlands have investigated the paradoxical tensions between economic and architectural values that are a part of the negotiations between client organizations and architects (Bos-de Vos, *et al*., 2015). Volker (2012) showed how new EU competition procedures, which promoted upfront specifications of success criteria, created a tension between artistic freedom in architectural design and bureaucratic procedures.

David Stark (2011) points at an important distinction between head-to-head competitions and architectural competitions. In head-to-head competitions such as soccer matches the referee can easily calculate and "count" who score most goals. In an architectural competition, however, the criteria to pick the winner are less well defined because the jury board develops the criteria of evaluation during the valuation process. In traditional open architectural competitions the jury board select a design without knowing the identity of the architect behind the entries (Kazemian and Rönn, 2009). Empirical studies of the jury boards' work in different kinds of anonymous competitions have found that some of the evaluation and assessment criteria is developed during the process (Silberberger, 2012; Van Wezemael *et al*., 2011). Recently, new forms of competitions have emerged that that allows for face-to-face interactions such as dialogue-based competition procedures. These are being used in Danish construction projects like public schools (Kreiner, 2012; Kreiner, 2010; Kreiner *et al*., 2011) urban development projects (Georg, 2015) and hospital constructions (Harty *et al*., 2015). During the interactions the client organization can get insights into economic and functional aspects of the future building before a design is selected. The dialogues between the jury board, future users and architect teams can facilitate mutual learning processes, because the teams can integrate inputs from future users and other stakeholders before the final project is submitted. Empirical studies have found that dialogues in a competition speed up learning processes. Yet it is also difficult to learn in such dialogue-based competitions because the feedback that the architect teams get can be ambiguous (Kreiner *et al*., 2011). In dialogue-based architectural competitions the criteria for selecting a winner are not a priori given, instead they emerge as a part of the competition process, and they are based on the jury members' professional judgments of the designs (Kreiner, 2012).

In our case the client organized the specific competition procedure, because they wanted to *see* how the four different invited architect-teams developed their designs, and how they presented themselves as a potential collaborative team for a jury board. The winning team was awarded the right to further develop their building design together with the client organization after the competition ended. The competition brief comprised a building project of more than 80.000 square metres with a budget of

1.3 billion Danish kroner (DKK), or approximately 170 million Euro. The building had to be finished within a strict timeframe, because the main user was a University College with 10.000 students. These students were scheduled to move from different locations in Copenhagen to their new campus in the building. The campus building is scheduled to be opened fall 2016. When finished it will consists of 29 stores and its 100 metres height will make it among the tallest buildings in Copenhagen. The building is also part of the development of a new major 600.000 square metres city area, the Carlsberg City District.

We describe and analyse the work of designing and selecting the design for the building as a *wicked problem*. Rittel and Webber (1973) defined wicked problems as complex societal problems with no optimal solution. Wicked problems entail contradictions and it is not clear how a wicked problem should be defined and solved. They might be solved in a number of different ways - depending upon peoples' "world view" (Rittel and Webber, 166) - and are therefore different from tame problems where an optimal solution exists. Rittel and Webber's distinction between wicked and tame problems draws attention to the knowledge conditions within which a solution to a design problem is worked out. More specifically, the distinction underscores the fundamental uncertainty that characterizes the wicked problem, i.e. a condition where there is no certain knowledge regarding what the problem is, nor about methods for solving it.

We are not the first to link building design and construction to the concept of wicked problems. Winch (2010) relates the distinction between tame and wicked problems to different phases in a project. For tame problems it is sufficient to rely on prior knowledge and it is clear where the boundary of the design problem and solution lies. By contrast, for wicked problems, prior knowledge is not sufficient, nor is it possible to fully describe the boundary of the design problem and the solution (Winch, 2010). The problem boundaries are unclear in the architectural competition, where different solutions are being developed and explored before the jury selects a winning solution. Other researchers have used the concept in relation to a study of an architectural competition (Kreiner, 2012). Based on an empirical study of a dialogue-based architectural competition for a public school Kreiner shows that the problem has no analytical solution. The nature of the design task is discovered during interaction and addressed sequentially when the participants in the competition are working with the problem (Kreiner, 2012).

A few studies have approached the study of the architectural competition from an actor-network theory (ANT) approach focusing on BIM (Sørensen *et al*., 2015) and the role of a sustainability assessment tools in a competition (Georg, 2015). The ANT approach has been put to good use in exploring the role of the visual devices in knowledge intensive contexts such as scientific laboratories (Latour, 1986), and more recently in construction management contexts when exploring visual and virtual representations in hybrid design practices (Harty and Whyte, 2009; Harty *et al*., 2015).

In this paper we use ANT to explore how the wicked problem is being reconstructed as it emerges in practice during the architectural competition, by focusing on how contradictions and tensions unfold in the dynamic interplay between visual representations of the building and the design team during the dialogues at the workshop. We seek to explore how this verbal aspect of the interaction between the jury board and the teams changes the role of the visual during the competition process. The role of visualizations are different when competitions are organized so that

architect teams can discuss their work with the jury board before they hand in their final design proposal. Yet, it is an open empirical question how the role of the visual changes, and more specifically, what roles the visual can play in generating new ways of viewing and (re) constructing the wicked design problem during the dialogue-based competition.

METHODOLOGY AND DATA COLLECTION

Our case study is based on a comprehensive dataset spanning the entire competition process. We observed planning-meetings before the competition process, all 12 workshops (each architect-team had three workshops with the jury board), and the final meetings of the jury board. We also conducted semi-structured interviews before, during and after the competition process with key informants, and took more than 200 digital photos of the work at the workshops, audio recordings from all 12 workshops. After the presentations we collected the power point presentations used by the teams at the workshops. The data collection started one month before the process competition began, with observations of meetings were members from the client organization together with consultants from the Danish Association of Architects were writing the competition brief and planning the progression in the workshops and the competition process.

In these observations focus was on the work of preparing for the competition process. The researchers were provided with agendas before the meetings and with access to a shared digital folder (Dropbox) where documents and pictures were uploaded. When the competition started focus was on how the architect teams were presenting their design visualizations and team organization at the workshops, and how they engaged in dialogue with members from the jury board and further negotiate the overall design task and challenges. We focused on how the understanding of the design task and problem developed in the negotiations at the workshops.

Our aim was to develop an understanding of how the on-going feedback and evaluations of the teams' designs at the workshops had an impact on the (re)formulation of the wicked problem. The aim of using different methods such as observations, semi-structured interviews, documents, and digital photos was to understand how visualizations and materiality was a part of the studied practices of problem identifying, setting, negotiating and reproducing. Our case story is organized accordingly: first, the reader is introduced to the background, which involves a large city development project. Next we focus our case description on the particular project task of designing a house within this larger city development project. Our case description and analysis focus on how one of the architect-teams approach the wicked problem at the first workshop in the competition, and furthermore, how the team then interact with the jury board and use visualization devices during the workshop and with what implications for the reconstruction of the wicked problem.

The Case of a Dialogue-based Architectural Competition

Developing Carlsberg City

When the Carlsberg Group decided to move their brewery to Jutland they left a large area of 33 acres situated in Copenhagen. The area is very attractive for development and is being turned into housing, business, educational institutions and recreational area. In 2006 Carlsberg organized an international open architectural competition to find a master plan for the Carlsberg City District area. 221 proposals were handed in and the winner of the open competition was the Danish architect firm Entasis, with a

proposal called “Our space”. One idea in the selected proposal was to reintroduce the density of the classical city. The vision of the master plan is to develop common spaces with inspiration from sociology, architecture, art and engineering to create a socially, economically and environmentally sustainable city.

An important source of inspiration is Giambattista Nolli's plan of Rome from the 18th century – the Nolli Map. To define the spatial contours of squares and buildings the master plan used the seven kilometre underground system of cellars that had been established by the brewery to store and transport beer. In the master plan the common spaces and the 'life' between the houses are considered more important than the buildings themselves to develop a coherent city. Therefore, the selected plan is also a critique of the modernistic epoch of city planning, because the buildings are isolated here. The public spaces outside - and between- the buildings are very important in the master plan.

The new Carlsberg City District is designed according to variations in scale in the master plan, because the idea is that one should be surprised when people walk around the city. On the one side the master plan is inspired by the small scale classical city houses common around Copenhagen, but also introduces towers, a new aspect in Copenhagen where the city skyline has been strictly regulated with limitation on building height. During the process competition the client organization negotiated with potential future users of the building. As it turned out, one of these prospective users did not fit very well with the small town design concept and user identity inscribed into the master plan. The new and very large user that emerged after the master plan was finalized was the University College and it wanted to establish a new campus for 10,000 students. Therefore the design competition became not only a way to visualize how the University College could be a part of the future building, but also how this very large user and building could fit in with the ethos of the master plan. As the largest tenant and user of the prospective building the University College was granted representation in the jury board and its workshops.

CASE ANALYSIS

First act: Setting up the stage - organizing for competition

The team experience tensions around addressing the competition brief, dealing with the competition and setting up the organisation and team working. The workshop starts with the team visualizing how its members are sitting around a table in an office at one of the architect firms. The team members tells that the picture on the power point is taken the evening before the workshop, and that the team proceeded with their work the entire night. The team members consists of representatives from five architectural firms. They point out that this competition confronts them with a novel situation. Despite that several of the firms has been around for many years and have accumulated experiences from numerous architectural competitions, none of the five firms has ever participated in this new dialogue-based form of competition. This new and largely unknown condition prompts the team to visualize their organization with the help of digital images embedded into their power point presentation.

The team links the picture of their organization with a metaphor. The five "farms" (architectural firms) have all produced some products that they have developed on their own, and now the farms have teamed up to deliver this bigger project (the building). Therefore the team have established a co-operative dairy (the producers own the production facilities). The team tell the jury board that they have yet to decide how to divide the design task; whether in 5 parts according to the number of

firms/farms, or if it is more appropriate to divide the design of the building into 12 or only 3 parts, according to the overall design task. As Rittel and Webbers argue the criteria for finding the solution on the wicked problem depend on how to solve it. In practice the team approach the brief to re-construct the problem. The team also tell the jury that their challenge is to secure diversity, i.e. to take due account of the overall design task, when they organize their team as a 'collective' drawing office. The team does not know if they need a 'filter' or a design steering committee. Last but not least, the team supplement their visual presentation and story with questions addressed to the jury board, such as:

"What will be the most productive for this process?"

One of the architects in the team point out that it is important that one can see the diversity in the design of the building and that it is designed by different architectural firms. The overall design task and challenge is that some functions and spaces in the building are very large. The building program - another visual representation that supplements the master plan and the Nolli map - stipulates for the University College, that this functional space (education facilities) alone will it take up 54,000 square metres. It is a particular design specification that is being mentioned by the team members as part of the overall design task and it becomes a challenge in the context of a master plan and its design concept of a 'Carlsberg city' as a town with small-scale houses. The team thinks that both their organization and the architectural strategy have to be dynamic. The team want to match the dynamic of the design problem by organizing in a dynamic way. One architect says:

> We don't know where this ends. Therefore we decided that we need to have an organization that is just as dynamic as the process that we are in

The team tells the jury board that they are in a phase were they have to "think before they draw". They call this phase were they are right now up to and into the workshop as an "analytical phase". The analytical phase is not only about understanding the essence and substance of the overall design problem, as well as the vision and background for the development of the Carlsberg City District, but also about probing and adjusting values with the jury board. Therefore the team explore potential re-solutions on the wicked problem and develop their team organization to do that. The team also point out that the five firms in the team each have some significant attitudes, and that they used the first week from the kick-off day until the first workshop to adjust design attitudes and values internally in the team. Now, the team is working on understanding the vision for the Carlsberg City District, and the total of 80.000 square metre in relation to the overall building program and the functions. The team tells the jury that they think that the master plan and vision for the Carlsberg City District is fantastic because it puts the lives between the buildings – the humans in the fore. The team's interpretation of the problem is focused on integrating the two visions and their tensions: The large scale University College and the small scale Carlsberg vision.

Second act: The team's use of visualization devices

The team use visualization devices as addressing but also reproducing and contributing to the wicked problem. To bring the two visions together the team use the Nolli map as a device. But the team explain that they will use the Nolli map in another way than it is used in the master plan. While the Nolli map in the master plan is used to project a view of the contours of the basements and the 7 km long corridors below ground, the team instead use the Nolli map to project a view above ground. It is a 3D visualization and design of the zones were the building meets the squares and

spaces around the building above the ground. In effect the new use of the Nolli map reconstruct the problem boundary from a focus on the building and what is going on below ground, to a more complex design problem taking into account the spaces for social interaction above ground and between the building and the surrounding city. The team is now talking about the challenge of establishing an inner flow in the large building and connecting this flow with the rest of the Carlsberg City District. To do this the zone where the building meets the space around the building is important. One of the architects is also referring approvingly to the power point and film presentation made by the representatives from the University College at the “kick off” day where one of the user representatives presented the life of the students while explaining that the University College wanted to be a part of the new city. In association with visual devices such as power points and film, the architects' novel use of the Nolli map afforded this more complex view and reconstruction of the overall design task and challenge.

Some aspects of the master plan are easier to translate into to the design of the building than others. When the different functions for the large building have to be translated into a coherent design for the entire building a number of concerns, conflicts and contradictions emerge. These tensions between the large building and the master plan concept of a small scale village emerge due to the use of the Nolli map. The "world views" of the master plan and the University College campus are conflicting in terms of scale and constitute new and more specific design problems. For example, the jury board and the team discussed how the many future students were supposed to move around and use functions and spaces inside and outside the building.

During the dialogue the team and the jury board touch upon several connected problems. During the first act the team raises questions at the workshop, but the following dialogues with the jury board also raises new questions. Intervening in this process of dialogue and problem definition are devices for visualization that affords new views and perspectives on the design problem. When the team presents their ideas and visualizations of the building it became clear how some aspects and concerns such as the building's scale and use in the context of the surrounding city reconstruct the boundary of the wicked problem in new and conflicting ways. The new knowledge produced does not tame the wicked problem. Rather it reveals new uncertainties and makes participants more knowledgeable about what they do not know or have not yet considered and thought about. The design problem being (re) constructed appears as Heracles' fight with Hydra: Every time Heracles cut of a head, two new heads grow back. The problem remains wicked, although it has changed by considering the challenges in the spaces above ground and in between buildings. Yet, the inputs that the team get out of the dialogues cannot be easily integrated into one consistent solution. The team leaves the room and the jury board discuss the presentation for about ten minutes.

Third Act: The jury board's response

When the jury board discuss and evaluate the team’s organization and their visualizations the tensions between the building and the public spaces are still present. Different views emerge in connection to the Nolli map. One member of the jury board thinks that the idea about using the Nolli map in this new way is interesting. Another member of the jury board point out that they have to be careful that the building is being designed in a way so that the 10,000 students are just staying inside the building. The jury board is talking about how they have to be careful not to design

a new Field's (a shopping mall in another part of Copenhagen) – not with stores but with an educational institution, that will not add value to the city life with the potential that the 10,000 students have. This shopping mall leaves the streets around the building empty. Such a design of the building is not directly in conflict with the ambitions of the new University College, but the central idea in the master plan is that the spaces in between the houses have to be designed before the buildings, because the ambition of the master plan is to connect the common spaces and squares. The building that is being designed and developed is different from the buildings that were defined in the master plan, visualized as smaller traditional city houses, because it is so large.

When the team is back the jury board tell them about their concerns about the students that arrive at the building in the morning and leave it in the evening without getting out of the building during the day and without having contact with the city. One member of the jury board tells the team that the University College needs the process to facilitate the organizational change to become University College Central and that it is not a bad thing with the inner flow in relation to this development process, but it is also a good thing if there is a vibrant exchange - a dialogue - between the University College and the city spaces. It is important for the University College that it is possible to read in the façade what is going on behind the walls. One should be able to see its function; a classroom, a library, a canteen or another common room. From the University College perspective the building is seen and understood from inside out in relation to educational functions – even though that the city space is also important. It is being discussed that the students might be willing to go outside if there are attractions outside. The team is also discussing the other future users with the jury board. Many people, not only students and faculty, will arrive with the train and walk into the future city. But other people will also dwell and live inside the tower in the building. The way the multifunctional building is being perceived by the different members in the jury board differs. One of the jury members asks the team about their thoughts about the area around the train station and the parking facilities in the basement of the future building. The team haven't thought about this yet. This further consideration of infrastructures in the vicinity of the large multifunctional building, such as train stations and transportation of different users, adds new elements to the wickedness of the problem.

It is clear already in the team's presentation that it is challenging to integrate the vision for the University College together with the vision for the Carlsberg City District as it is formulated in the master plan. The tension between the large building and the small scale city spaces becomes explicit during the team's discussion with the jury board. The integration of the large building in the master plan creates dilemmas and conflicts in the discussion between the team and the jury board, but also internally in the jury board. The contradictory elements of use to be integrated in the future building, such as campus building, dwelling and shopping, can be handled in different ways. Because the problem is not tamed but becomes wicked in new ways the team does not know how the tensions between inside and outside will be reconstructed and resolved through the final jury decision.

These new elements of the wicked problem emerge during the dialogue and direct the attention of the team and jury board towards certain design challenges. Yet, these design challenges cannot be solved through consensus at the workshop. When the team is visualizing their design solutions they can see and know more about how the problem is wicked. The new knowledge does not solve the design problem and

challenge. Instead, it adds to the wickedness of the problem by opening up for new and more complex relations between the building and its users and the surrounding city spaces and functions. The team has to take these new elements and relations into account when developing their design for the next workshop. There is no optimal and final solution. The wicked problem is an evolving one and compromises must be found between elements and related problems. How to find these compromises is the design challenge that the team is confronting. The dialogue-based competition is not a means for solving the wicked problem, but a mechanism that makes it possible to (re)construct it through the simultaneous use of different forms of visualizations and the new views and knowledge that is produced.

CONCLUSIONS

As Rittel and Webber (1973) argue there is not a well-defined or optimal solution to a wicked problem, eventually its resolution depends upon peoples' world views. Our case analysis shows how such "world views" about the task and challenge of building design, construction and city development are (re)constructed through the dialogue-based architectural competition. Integral to this design problem are dialogues within a setup consisting of visual devices such as power point presentations, text, still images, film, physical models and sketches. During the first act the competition brief outlines the contours and boundary for the design problem with a focus on the large building. This problem definition is challenged through the team's novel use of the Nolli map, which forge a connection to the overall masterplan and spaces between buildings. The team's presentation of their visualizations produced new knowledge about the wicked problem. On the one hand the team's use of the Nolli map is loyal to the master plan, yet it also created tensions between the design of the large multifunctional building and the master plan vision of a small scale Carlsberg City District.

The wicked problem is not solved, only (re) constructed. During the dialogue-based competition the visualizations of the building is opening and closing opportunities for accessing new knowledge about the design problem. Another kind of complexity and uncertainty comes from the competition. Criteria for what counts as winning approach to the design problem, such as the novel use of the Nolli map, is not specified up front in the design brief. When the jury board finally selects a winning design approach, the teams do not know what criteria count most. Instead, such criteria emerge only to be known at the end of the competition (Kreiner, 2012). The teams are confronted with two kinds of uncertainty with respect to the phenomena of the wicked problem: 1) the teams do not know what problems will emerge at the workshops; 2) it is uncertain what aspects count most in the final jury decision. When the jury board finally selects a winner they have to evaluate the architectural quality of the proposals, how the teams organized as a team, and how they reacted when fighting with Hydra at the workshops.

REFERENCES

Bos-de Vos, M, Volker, L and Wamelink, H (2015) Prioritizing quality over profit: Value trade-offs within architect-client relations. *In*: A Raiden and E Aboagye-Nimo (Eds.) *Proceedings 31st Annual ARCOM Conference*, 7-9 September 2015, Lincoln, UK. Association of Researchers in Construction Management, 753-762.

Georg, S (2015) Building sustainable cities: tools for developing new building practices? *Global Networks*, **15**(3), 325-342.

Harty, C, Tryggestad, K and Jacobsen, P H (2015) Visualisations and calculations of spaces: Negotiating hospital design during on-boarding. *In*: A Raiden and E Aboagye-Nimo (Eds.) *Proceedings 31st Annual ARCOM Conference*, 7-9 September 2015, Lincoln, UK. Association of Researchers in Construction Management, 875-884.

Harty, C, and Whyte, J (2009) Emerging hybrid practices in construction design work: role of mixed media. *Journal of Construction Engineering and Management*, **136**(4), 468-476.

Kazemian, R and Rönn, M (2009) Finnish architectural competitions: Structure, criteria and judgement process. *Building Research and Information*, **37**(2), 176-186.

Kreiner, K (2010) Paradoxes of architectural competitions: The competition between efficiency, justice and creativity. *In*: C Egbu (Ed) *Proceedings 26th Annual ARCOM Conference*, 6-8 September 2010, Leeds, UK. Association of Researchers in Construction Management, Vol. 1, 441-50.

Kreiner, K (2012) Organizational decision mechanisms in an architectural competition the garbage can model of organizational choice: Looking forward at forty. *Research in the Sociology of Organizations*, **36**, 399-429.

Kreiner, K, Jacobsen, P H, and Jensen, D T (2011) Dialogues and the problems of knowing: Reinventing the architectural competition. *Scandinavian Journal of Management*, **27**(1), 160-166.

Latour, B (1986) Visualization and cognition: Thinking with eyes and hands. *Knowledge and Society*, **6**, 1-40.

Rittel, H W and Webber, M M (1973) Dilemmas in a general theory of planning. *Policy sciences*, **4**(2), 155-169.

Silberberger, J (2012) Jury sessions as non-trivial machines: A procedural analysis. *Journal of Design Research*, **10**(4), 258-268.

Stark, D (2011) *"What's Valuable?" In*: J Beckert and P Aspers (Eds.) *The Worth of Goods: Valuation and Pricing in the Economy*. Oxford: Oxford University Press, 319-338.

Sørensen, N L, Frandsen, A K, and Øien, T B (2015) Architectural Competitions and BIM. *Procedia Economics and Finance*, **21**, 239-246.

Van Wezemael, J E, Silberberger, J M and Paisiou, S (2011) Assessing 'Quality': The unfolding of the 'Good'- collective decision making in juries of urban design competitions. *Scandinavian Journal of Management*, **27**(1), 167-172.

Volker, L (2012) Procuring architectural services: Sensemaking in a legal context. *Construction Management and Economics*, **30**(9), 749-759.

Winch, G M (2010) *Managing construction projects: An Information Processing Approach, 2nd edition*. Abingdon: Oxon: Wiley Blackwell.

THE ARCHITECT AS GLEANER: DESIGN PRACTICE AS PERFORMANCE IN THE ARCHITECTURAL OFFICE

Peter Raisbeck[1]

Faculty of Architecture Building and Planning, Masson Road, The University of Melbourne, VIC 3010, Australia

With the rise of digital software and BIM work practices the architect's office is increasingly seen as a knowledge intensive digital workplace. Digital technologies are blurring the line between physical and virtual work practices both within and outside of the firm. Internally, physical and virtual workflows are now obviously interconnected. Externally, architects are now digitally connected to various stakeholders including clients, builders, consultants and sub-contractors. Yet, as a digital workplace few studies have looked at the work practices that have emerged out of this situation. An ethnographic investigation of two small architectural firms occupying one space is presented. In this case, ethnographic methods of observation via site visits, written and drawn notes, and noted conversations are utilised. It will be seen how work practices within the firm can be described as a series of narrative performances that sometimes produce design knowledge. The performance narratives and material culture of the office indicate that the architect is a gleaner of design knowledge. Architects perform these narratives in order to gather together disparate, data and information from a range of information sources. This results in the creation of design knowledge. Finally, the ethnographic methodology and methods employed in the study are briefly evaluated in order to understand how such research methods might be applied to other design and construction contexts.

Keywords: design practice, digital practice, hybrid practices, ethnography, gleaning

INTRODUCTION

To the outside observer the architect's office or studio appears to be both glamorous and mysterious. The sense of glamour is associated with the construction and delivery of an iconic or high profile or luxurious building. Much has been written about the star architects who seem to obtain prestigious commissions. Images of architecture offices often depict bright, pristine spaces replete with minimal furnishings and well placed physical models, maquettes and drawings in the background. However, for many researchers, and despite the importance of design, these localities are mysterious in the sense that few people, including contractors and associated engineering consultants, fully understand what happens within them. As a general comparison, more research effort has been directed to understanding the construction site and the organisations that support construction than architect's offices.

Nonetheless, architects remain responsible for the design of buildings and the design practices, which enable architects to design, has been studied in the past from

[1] raisbeck@unimelb.edu.au

Raisbeck, P (2016) The Architect as Gleaner: Design Practice as Performance in the Architectural Office. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 771-780.

numerous perspectives. Lawson's work exemplifies this as he has worked written extensively on design practice, knowledge and expertise (Lawson, 1994, 2006, 2012, 2013). But, with the rise of digital work practices architectural work has been progressively transformed. Architect's offices are increasingly portrayed as being on the cutting edge of the new regimes of parametric design, BIM, 3D scanning and printing, CNC fabrication and robotic manufacturing (Mallie, 2016). Enthusiasm for these different technologies, suggest that in the architect's office the future is already here and that the architect's office is a site where these technologies are seamlessly and easily bought together (Garber, 2016). In other words, these depictions of the architect's office suggest that design practices take place entirely within a contained and holistic bubble of digital technology.

The idea that all architectural design, documentation and drawing work now takes place in the digital realm is, at face value, obviously incorrect. Firstly, different architectural firms have different design practices as well as different levels of digital capability. Both technical capabilities and design practice are a function of a firm's IT infrastructure, software as well as the training and skills that architects bring to bear on the work.

Given this context ethnographic research was employed as a useful way to dissect the depiction and representation of the architect's office as a seemingly integrated and complete digital-technical nexus. Ethnographic research, alongside emerging trends in digital ethnography, point to new ways of apprehending the divide between the virtual, actual localities and physical practices. (Pink et al., 2016). As Löwstedt (2015) notes by citing Brewer (2000): ethnography is the study of people in naturally occurring settings or fields. By using ethnographic methods to examine the architect's office as a locality of design practices this research establishes that the situation is more nuanced and complex than might be suggested by those industry players, such as software vendors, who strongly advocate a kind of immersion in digital design practices.

The research aimed to highlight the nuances, variations and conflicts, of the socio-technical conditions that underpin the connection between design and digital practices in the architectural firm. By pursuing a short ethnography of an architect's office the research sought to question the extent design practices were connected to both the digital and the non-digital realm in the firm.

Previous core research

As Pink et al., (2010) argues ethnographic research is a way to understand the different practices involved in people, creating, learning, knowing, and transmitting knowledge. Consequently, a number of efforts have been made to examine architectural work practices using ethnographic methods. However, these studies have not looked at the architectural office as a situated field suitable for ethnographic research. For example, Maciel (2015) conducted ethnographic research by only observing design review meetings to investigate collaborative design and observed how designers responded to design changes. Webster (2006) conducted a yearlong ethnographic study in a British architecture school to understand design juries. Ibrahim and Farzad (2010) used ethnographic methods to understand communication and information synchronisation during the conceptual design phase of projects. In other work Mewburn (2011) used ethnographic methods to examine the relationships between architecture students and design teachers. Mewburn concluded that both gestures and representational methods, such as drawing, situate "the bodies of teachers

and students amongst a crowd of non-human others who participate together in design knowledge making practices" Mewburn (2011).

In contrast, situated ethnographic research focused on construction sites has not been as unusual as it is in architecture. For some Construction management researchers this has been a counter too more normative, quantitative and positivist research methodologies (Phelps and Horman, 2009). For example, Thiel's participated over a period of 51 weeks as a laborer on three connected building sites in London in 2003 and 2004 (Thiel 2007, 2012). Highlighting the working body in space Lyon (2013) utilised visual modes of enquiry, using a portfolio of ethnographic techniques, but primarily visual techniques including photography, to observe activities on a construction site. In a short ethnographic study of a building site Löwstedt (2015) sets out in detail how the ethnographer can understand the "variations, contradictions and tensions underlying practices" of a particular place that may not be available through traditional research methods.

As Rooke et al., (2013) proclaim, to be an effective ethnographic researcher ethnographer or participant observer a researcher must "produce an adequate account only to the extent that he or she appreciates the understanding of the setting which any other member of that setting would have." This is the first adequacy requirement of ethnographic research. As an architect with extensive experience in small architectural offices I meet this criteria. The strong adequacy requirement as a standard of ethnographic research is more problematic. As Rooke et al., (2009) succinctly note this benchmark is a negative: "refusing the use of theory to inform the fieldwork." Hence, the research should not be the subject to any a priori theorising or interpretations informed by pre-existing theories. Rooke, *et al*., (2009) argue, "…the strong requirement restricts the analytical devices used in the report to those already present in the setting."

Ethnographic method

The initial focus of this research was to allow the artifacts that existed outside of the computer, or realm to be represented in a way that accords them an equal autonomy with the digital screens and machines in the office. As the observation proceeded I employed hand notes and annotated sketches to record my observations. My aim was as an ethnographic researcher recording was to remove any distortion from observing the setting and translating this to paper. A mixed approach using digital means, for example taking photographs or video recordings, might lead to overly fixed and exacting interpretations; distorting or complicating the analysis of the locality. I felt that by recording everything in one media using non-digital means I would ensure a consistent analysis. By using this method the initial description of the locality and the activities within it are recorded and translated in a way that is, in a sense, part of and congruent with the setting itself.

The ethnography was short and comprised of 4 hours each week in the firm for a total of 5 weeks. At the time of writing the research is ongoing. The location was visited 4 times prior to the actual visits. The work is continuing and it is intended that the work will be conducted over 3 to 6 months. During the first phase of the research the researcher gained access to the firm and had preliminary conversations with architects in the office to ascertain their attitudes to the research taking place. This paper draws material from around 100 pages of recorded and annotated notebooks.

FINDINGS

A range of different events and things were recorded in my research notebooks. The notes marked, described and recorded times, events, locations, positions, gestures, words, conversations, materials and items. This included the times people entered and left the office. Information about office conversations as well as external conversations via phones were noted. The way people moved within and across the office were recorded. The type of computer software people were using at particular times was recorded. As briefly outline below physical materials and different tools in the office were listed. This also included mapping the arrangement of materials and tools on people's desks. Data of conversations with myself as the embedded researcher in the office were also noted in my notebook. There was no initial or orthodox plan to this recording exercise and whilst the objective was to be comprehensive I was intuitively guided by what was happening at any particular point in time in the office.

Material culture

Interestingly, the office had just moved to this new location and I was informed that in the physical move "about 20% of office material" had been thrown out. Overall the desks and tabletops of the office appeared to be literally strewn with materials and tools. This material all appeared to be arranged in different ways, and shifted from day to day, depending on its location in relation to an architect's workstation. Everything, as noted below appeared to be distributed and scattered throughout the office. There was a storage area for these samples but many of them were also aggregated on the desktops. An extensive but by no means exhaustive list of things in the office includes:

Furniture: The desks, trestle tables, conference table, shelves and shelving, bins (12), IKEA filing drawers, chairs of various kinds filing trays, mouse pads,

Tools: pencils, highlighters, pens, paperclips, glue sticks, cutting board, rulers, measuring tapes, erasing shields, erasers, elastic bands, sticky notes, tape, hole punches, different types of folders, and archive boxes, calculators, keyboards, pens, pencils and scissors.

Machines: computers, mobile phones, laser printer, plan printer, pencil sharpener, phones, power cords, power adapters, as well as fridge, dishwashing machine and a coffee machine.

Paper: paper of all different formats, printer paper, butter paper, tracing paper, serviettes and business cards.

Models: the office also contained drawings, A2 presentation boards, and framed awards. Various models of different scales and sizes including, physical cardboard models of projects constructed in different materials and made at different scales.

Material: carpets, tiles and vinyl, paint and paint samples of different kinds, samples of different types of timber and aluminium samples. Paint tins, roof deck samples, timber samples, glass samples, paint swatches, laminate samples, trade folders and aluminium sections.

Books and magazines: Trade folders, books and magazines, mostly about architecture along with audio-visual materials in the office such as DVDs.

Performance

In the office I was witness to performances that involved and bought together people, machines, and other various manual tools. Like the construction site the architect's office is a theatre of performance. Performance is defined here as the act of presenting and should not be confused with the more positivist definition of performance as an act that is about performing a task or an achievement. Each performance narrative, as I have designated them, is comprised of movements in space, gestures and vocalisation. Different props or tools may be engaged as each narrative is constructed or enacted. Each performance narrative appeared to be unique.

Each performance narrative appears to be constructed from a number of individual units and a linguistic analogy appears to fit this interpretation. Each performance narrative can be said to have both a semantic and a syntactic dimension. Meaning is created in each narrative as the architects bring together different disparate items available in the office's material culture. Four narratives are described below and this information has been directly translated from the notebooks. Each of the narratives below was chosen to indicate the range of purpose as well as the different syntactic elements evident within each narrative in this office.

Performance Narrative 1: The technical information performance narrative.
In this performance narrative questions to an external party and information about technical issues is relayed across the space of the room. Vocalisation is the primary mode of the performance and the narrative is technical. One of the architects, a director of the firm, is on the phone talking to a building surveyor responsible for certifying the project. Everyone in the office can hear one end of the conversation as the architect vocalises his questions and the discussion with the building surveyor. The discussion concerns technical arrangements and regulatory requirements to do with exhaust venting on a project. The discussion takes place over a period of 13 minutes. At the end of the conversation the architect, without moving from his desk relates the detailed technical information from the conversation across the room to another architect in the space. He then moves onto another task. But, 5 minutes later the other architect responds with a question. Jointly a decision is discussed and made. The entire exchange takes about 15 minutes to twenty minutes to complete. Everyone in the office can hear the information being relayed. Presumably this implies that anyone else who may wish to contribute to the discussion can.

The entire performance appears to have an integrative function inasmuch as other people in the office can add their knowledge, or veto aspects of the discussion. Presumably at some point the conveyed information was translated to the computer drawings.

Performance Narrative 2: The design detailing narrative.
In this performance narrative the placement, design and construction of solar roof panels is discussed. Digital searching, hand gestures, sketching and vocalisation are the primary modes of this narrative. I observed that one architect has a completed Google image search on his keyboard. The search depicts a series of solar panels and supporting structure on roofs. He has two screens to work with. As he looks at the images on one screen he is also looking at the images of a plan on the other screen and also referring to typed and printed notes on his desk. This activity takes place for about 90 minutes. The next act in this performance involved the architect walking to another architect desk to have a discussion about possible solutions and the

configuration of panels. A long discussion ensued that included each architect talking, drawing sketches on butter paper as well as using extensive hand gestures to describe different options for the structural sections and support details for the solar panels. The hand gestures are used to describe the placement, shape and orientation of the supporting steel sections.

In this performance narrative the design details of a particular component of a building is either partially or fully resolved.

Performance Narrative 3: The design charrette
In this narrative a series of drawings are place on the front conference table and three people are having a discussion around them. The primary modes of expression in the narrative are visual checking of the drawings, vocalisation and sketching. As one of the architects in the office remarked to me "I just have to have a pen in my hand to think properly about some things" The prints on the table were prints from a BIM modal and included plans. Three architects sat around the prints and sketched and at various times one of the architects repeatedly went to her computer to check something and then relay some information back to the group.

In this performance narrative the layout and design of a building plan is collaboratively explored.

Performance Narrative 4: The morning tea ritual
The morning tea ritual is a primary narrative in the office. A roster operated in the office and different people in the office were responsible for setting up and providing morning tea for everyone. This usually consisted of cheese and biscuits. This is because this narrative is a central part of the day because it always occurs at the same time each office workday. On each occasion it was observed at 11.00 am each morning a designated person would prepare tea and coffee and snacks for the entire office. All of the people then working in the office would gather around and then discuss a particular topic. The topic of discussion ranged from experiences in the profession, the problems of particular projects at hand or completely extraneous issues such as news items and what people were doing on the weekend.

In this performance narrative personal knowledge and opinions was explored and shared.

During all of these performance narratives most of the computers were on and the desktop screens were on framed various software. Only on one computer did there appear to be a predominant image of three-dimensional modeling. Mostly, the architects using the screens were looking at plans, word documents or spreadsheets. A lot of work appeared to be undertaken in terms of translating material or information from papers or documents in the office into the computer. A lot of time appeared to be consumed in this kind of data entry task.

DISCUSSION

Design practice in the small architect's office can be likened to gleaning. This is because the architect's office resembled a scrap yard and the pattern of design practice that emerges from performance narratives in the office is the idea that an architect is a gleaner. In the Agnes Varda film The Gleaners (2000) a gleaner is a person who hunts for food, knick-knacks, and thrown away or discarded items. Similarly an architect is a person who searches for, collects together, or gleans, data and information from various sources in order to create and generate design knowledge. As a participant observer in the office this initial thought was prompted by the way in which the

material objects in the office reminded me of the scrapyard and the waste pickers I had previously visited in Monterrey Mexico. The concept of the architect as gleaner was reinforced by the way the material artifacts and tools were distributed in the office and organised across the space of the office in an ad hoc fashion. Moreover, the office contained 12 substantial physical bins, in addition to each computer having a trash function in the different software programs.

Design practice is more varied and in conflict with the holistic image of digital practice. In this interpretation of the ethnographic data design knowledge becomes present and is communicated once it is created through performance narratives. These performance narratives are essential to the firm's design practice.

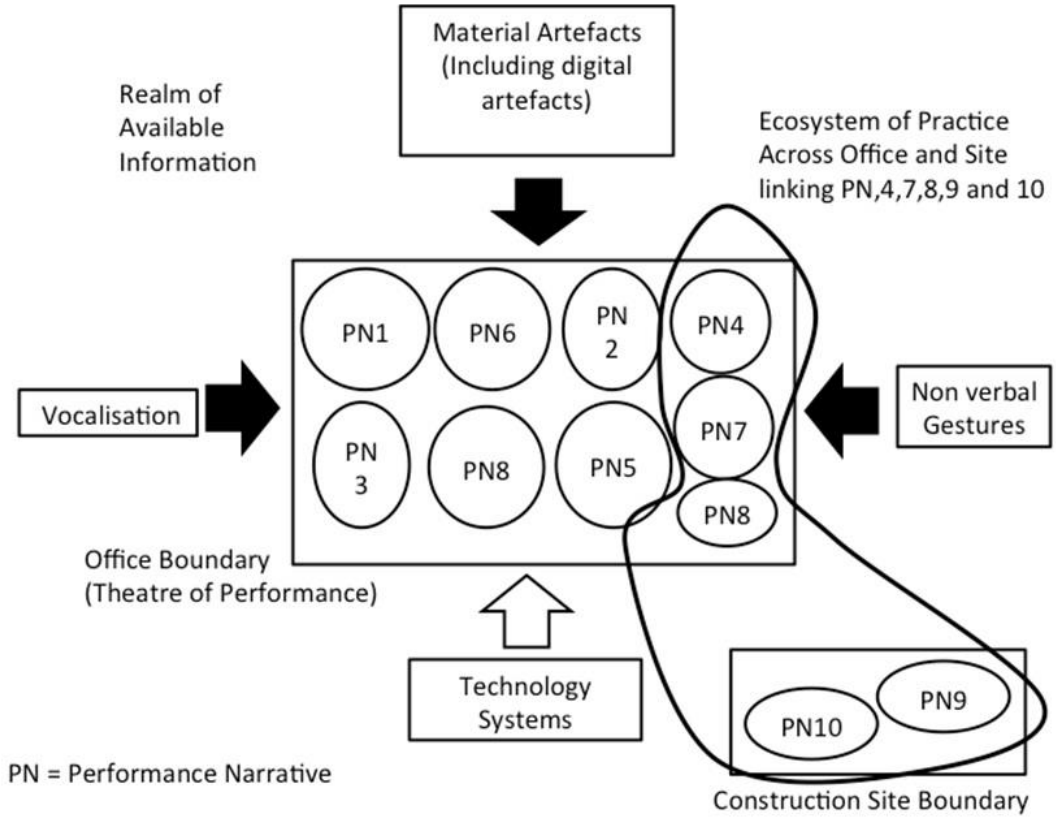


Figure 1. Perfomance Narative Ecosystem

The sources from which the architects glean information from are nuanced, varied and diverse. Whilst an architect may glean information from digital models or from the Internet; the architect will also glean information from any of the other material artefacts in the office. The contradiction is that in terms of design practice of much the information that is embedded and inscribed into the architects digital models in this office comes from a diverse and wide range of non-digital sources: including personal knowledge as expressed through hand gestures and vocalization; as well as information gathered and gleaned via communication devices, paper documents and all manner of physical materials as described above.

In research into a construction megaproject Harty and Whyte (2009) employ Actor Network Theory (ANT) to identify and describe ecologies of practice that delegate agency to both actors and nonhuman artifacts. Their work emphasises the importance of material artefacts in the formation and emergence of different work practices. They identify ecologies of practice that were hybrid "both in terms of their human and

material constituents, and in terms of the incorporation of new and localized factors." (Harty and Whyte 2009). However, the performance narratives identified here extend and suggest greater nuance and detail to Harty and Whyte's notion of hybrid ecologies of practice. This is primarily because the performance narratives constitute design practices that do not always give the same amount of agency to different gestures or artefacts. They are not simply the hybrid interweaving or contrasting dichotomies of human, nonhuman, material and digital, old and new, local and non-local elements. The performance narratives are primarily fluid, and constitute ecosystems of design practice aggregated around projects (Figure 1). As an ecosystem comprising different performance narratives design practice is self -adaptive depending on the circumstances of the project. Within this ecosystem architects are gleaners shaping the broader ecosystem as it adapts and changes to the different projects and technology in the office. As indicated in Figure 1 the office ecosystem may also extend outside of the office as performances take place on construction sites and also within the virtual world via web conferencing. Single, performance narratives may also solely take place within the computer as digital models are being developed. In the ecosystem of design practice knowledge is shared across different performance narratives. Design knowledge is translated from one performance to the next; each performance contributing to the bringing together, generation and resolution of design knowledge. For the architects as gleaners artefacts are important but so are gestures, vocalisation and the use of various tools.

Considering architects as gleaners and the performance narratives they create has implications for the way that technology and digital practices are introduced, implemented and then made productive in architectural firms. Design and project offices should be organised in a way that allows these performance narratives to be fostered and take place. This has implications both for workplace design but also for organisational management. Implementation of new technologies must foster these narratives and this might avoid the "plugging' and "patching" that Harty and Whyte observed (2009) in their study of the megaproject. Mechanical workflows, overly prescriptive hierarchies and transactional methods of management may inhibit the ability of architects to glean and work together as an ensemble to generate design knowledge. The digital-technical culture of the architect's offices could be organised in a way that allows its actors, or gleaners, to have immediate access to tools and material artefacts quickly enabling them to put together performance narratives that create design knowledge. This is at odds with a prevailing view that design knowledge is more and more created in the digital realm.

CONCLUSIONS

The performances enacted each day in the office by the architect gleaners all appeared to be different. Not all plays or performance narratives are successful and further ethnographic observation and research will establish how performance narratives constitute ecosystems of design practice, to design, construct and deliver projects. A longer non-participant observation of the office might reveal patterns across narratives or the recurrence of similar narratives. Even if this was the case my recorded and annotated observations suggest that the architect's office cannot be regarded as a site entirely given over to predetermined BIM style production techniques or workflow sequences. Again, further long-term observation would suggest if this was the case. But the current observations suggest that the performance narratives in the office are unique and stochastic and random events.

The seemingly short and basic ethnographic methods of observation and recording employed here suggests that these methods are extremely useful in understanding design practices that, form the outside at least, appear blurred between the digital and the non-digital as well as across locations. More importantly, the ethnographic methods employed here provides a lens that helps to account for the nuances, variations and tensions as design practices transform through technology. The potential rise of Artificial Intelligence in the future suggests that both digital and mobile computing will supplant design decision-making processes. Yet for Artificial Intelligence to be intelligent, as it were, it must acknowledge the primitive elements of design and construction decision-making. Both the material culture and the gestures of the performance narratives described here must be accounted for in the design and construction sector's digital future.

REFERENCES

Brewer, J (2000) *Ethnography*. London: McGraw-Hill Education (UK).

Garber, R (2016) No more stopping. *Architectural Design*, 86(1), 120-127.

Harty, C and Whyte, J (2009) Emerging hybrid practices in construction design work: Role of mixed media. *Journal of Construction Engineering and Management*, **136**(4), 468-476.

Ibrahim, R and Farzad P R (2010) Comparison of CAD and manual sketching tools for teaching architectural design. *Automation in Construction*, **19**(8), 978-987.

Lawson, B (1994) *Design in mind*. London: Architectural Press.

Lawson, B (2006) How designers think: The design process demystified. London: Routledge.

Lawson, B (2012) *What designers know*. London: Routledge.

Lawson, B and Dorst, K (2013) *Design Expertise*. London: Routledge.

Lincoln, Y S, Lynham, S A and Guba, E G (2011) Paradigmatic controversies, contradictions, and emerging confluences, revisited. *In*: N K Denzin and Y S Lincoln (Eds.) *The Sage Handbook of Qualitative Research*. London: Sage Publications, 97-128.

Löwstedt, M (2015) 'Taking off my glasses in order to see': Exploring practice on a building site using self-reflexive ethnography. *Construction Management and Economics*, **33**(5-6), 404-414.

Lyon, D (2012) The labour of refurbishment: The building and the body in space and time. *In:* S Pink, D Tutt and A Dainty (Eds.) *Ethnographic Research in the Construction Industry*. New York, NY: Routledge, 23-39.

Maciel Pinheiro Cavalcante Jnr, A; (2015) *Interaction in Architectural Review Meetings: Seeking Models of Collective Concept Creation*. PHD Thesis, University College London.

Mallie, Jonathan (2016) Ever faster but still very good. *Architectural Design*, **86**(1): 114-119.

Mewburn, I (2011) Lost in translation: Reconsidering reflective practice and design studio pedagogy. *Arts and Humanities in Higher Education*, **11**(4), 363-379.

Oh, M, Lee, J, Hong, S W and Jeong, Y (2015) Integrated system for BIM-based collaborative design. *Automation in Construction*, **58**, 196-206.

Phelps, A F and Horman, M J (2009) Ethnographic theory-building research in construction. *Journal of Construction Engineering and Management*, **136**(1), 58-65.

Phua, F T and Brown, A D (2011) Subjectively construed identities and discourse: Towards a research agenda for construction management. *Construction Management and Economics*, **29**(1), 83-95.

Pink, S, Tutt, D, Dainty, A and Gibb, A (2010) Ethnographic methodologies for construction research: knowing, practice and interventions. *Building Research and Information*, **38**(6), 647-659.

Pink, S, Horst, H, Postill, J, Hjorth, L, Lewis, T and Tacchi, J (2015) *Digital Ethnography: Principles and Practice*. London: Sage Publications.

Rooke, J, Seymour, D and Fellows, R (2004) Planning for claims: An ethnography of industry culture. *Construction Management and Economics*, **22**(6), 655-662.

Rooke, J A and Kagioglou, M (2007) Criteria for evaluating research: The unique adequacy requirement of methods. *Construction Management and Economics*, **25**(9), 979-987.

Rooke, C N, Rooke, J A, Koskela, L and Tzortzopoulos, P (2010) Using the physical properties of artifacts to manage through life knowledge flows in the built environment: An initial exploration. *Construction Management and Economics*, **28**(6), 601-613.

Rooke, J A, and Rooke, C N (2012) From interpretation to action. *In*: S Pink, D Tutt and A Dainty (Eds.) *Ethnographic Research in the Construction Industry*. New York, NY: Routledge, 141.

Sage, D J (2012) Building contacts. *In*: S Pink, D Tutt and A Dainty (Eds.) *Ethnographic Research in the Construction Industry*. New York, NY: Routledge, 91.

Son, H, Lee, S and Kim, C (2015) What drives the adoption of building information modeling in design organizations? An empirical investigation of the antecedents affecting architects' behavioral intentions. *Automation in Construction*, **49**(Part A), 92-99.

Thiel, Darren (2007) Class in construction: London building workers, dirty work and physical cultures. *The British Journal of Sociology*, **58**(2): 227-251.

Thiel, D (2012) Ethnography and flux: Identity and epistemology in construction fieldwork. *In*: S Pink, D Tutt and A Dainty (Eds.) *Ethnographic Research in the Construction Industry*. New York, NY: Routledge, 73-91.

Webster, H (2006) Power, freedom and resistance: Excavating the design jury. *International Journal of Art and Design Education*, **25**(3), 286-296.

Yalcinkaya, M, and Singh, V (2015) Patterns and trends in Building Information Modeling (BIM) research: A latent semantic analysis. *Automation in Construction*, **59**, 68-80.

WHY UNFAIR BUSINESS IS BAD FOR BUSINESS

Martin Loosemore[1] and Benson Lim

Built Environment, University of NSW, Kensington, Sydney, NSW 2052, Australia.

Unfair business practices appear to have become institutionalised in the construction sector, persisting for many decades despite the repeated criticisms of numerous government reports, researchers and commentators. It is argued that this intransigent culture is in part a result of no theoretical or empirical evidence to link unfair business practices with project performance. To address this problem, theories of organisational justice are used to examine how each dimension of fairness affects the behaviour of project stakeholders and to explore how this translates to overall project performance. A survey of 135 construction project participants from across the supply chain in the Australian construction industry reveals that there are three main types of unfairness in construction business relationships that are related to project performance: distributive and procedural fairness; interpersonal fairness; and informational fairness. It is significant that these categories diverge from mainstream organisational justice theory, suggesting that it needs adapting for a construction context. Based on this new evidence and refinement of mainstream justice theory, it is concluded that project managers should develop strategies to improve these three types of fairness on their projects if they wish to drive better project performance.

Keywords: business, fairness, justice, project performance.

INTRODUCTION

There is ample evidence to suggest that unfair business practices have become institutionalised in the construction industry. As far back as the 1960's reports such as Emmerson (1962) criticized the UK construction industry for its confrontational procurement practices and unfair payment procedures. In the 1980's NEDO (1983) re-exposed the same problems and in the 1990s they emerged again in Latham (1994) and Egan (1998). More recently, Wolstenholme (2009) found that despite a decade of intense analysis, debate and pressure for change in the construction industry, reform had only been 'skin-deep' and traditional confrontational ways of working were as strong as it was decades before. Similar reports in other countries which draw on the UK system have mirrored these findings. For example, in Australia, The Gyles and Cole Royal Commissions into the Building and Construction Industry (RCBCI 1992, 2003) exposed numerous examples of low integrity and probity, corruption, sham contracting, bullying and intimidation in the industry. While a few studies have addressed the issue of intra-organisational fairness (Raidén and Sempik 2013), there is a dearth of research into the fairness of inter-firm relations. The few exceptions include Kadefors' (2005) study of justice on two Swedish projects and Aibinu *et al.*'s (2011) investigation of the effect of fairness on the behaviour of Singapore contractors. While useful in using the theoretical concept of justice to understand the

[1] m.loosemore@unsw.edu.au

Loosemore, M and Lim, B (2016) Why Unfair Business Is Bad For Business. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 781-790.

construction sector, no researchers have yet explored how this may affect project performance. To this end, the aim of this research is to examine this relationship.

LINKING FAIRNESS WITH PROJECT PERFORMANCE

The link between the concepts of fairness and justice are well-established in the social sciences where four dimensions of organisational justice have been identified: (1) procedural; (2) distributive; (3) informational; and (4) interpersonal justice. Distributive fairness is the perceived fairness about the allocation of an outcome based on the inputs given (Tyler 2000). In a construction project context, we define distributive justice as the perceived fairness of contractual compensation based on the risks allocated. Procedural fairness is concerned with the perceived fairness of the policies, processes and procedures through which decision are made (Thibaut and Walker 1975). In a construction project context, procedural fairness can be defined as the 'processes' by which rewards, risks and opportunities are determined, and how disputes have been resolved around those issues. Interpersonal fairness relates to perceptions of being treated with dignity, politeness and respect and whether people feel valued (Tyler and Bies 1990). In a construction project context interpersonal fairness can be defined by how well project participants feel treated in terms of safety and human rights, politeness, dignity and respect; freedom of expression and association and; whether their opinions were valued. Informational fairness is related to the adequacy and quality of informational exchange among people and is built on the rules of truthfulness and justification (Luo 2007). In a construction project context, informational fairness is defined as the quality of information exchange during the enactment of decisions in construction projects and whether communications were open and transparent.

Perceived unfairness is a consequence of perceived injustice and over the last decade a considerable amount of research has documented how people in organisations respond to these transgressions. Cropanzano et al (2001) demonstrated a link between perceptions of unfairness and various worker responses, conceptualising it as a 'social reciprocation' where people tend to repay the actions of others with corresponding actions of their own. More recent research by Choi and Rainey (2013) show that these reciprocations are correlated with many cognitive, affective and behavioural reactions which in turn have been shown to affect organisational outcomes. These include: job satisfaction; work quality; productivity (work slower, do the minimum); safety (take short-cuts, ignore safety instructions, lower compliance); communications (reduced communications, ignoring instructions etc.); teamwork (damaged interpersonal relations, don't collaborate, don't communicate, don't participate); conflict (get your own back, fight back); disharmony (lack of trust in management) and; morale The relationship between different types of perceived justice and organisational outcomes is quite complex. For example, Cohen-Charash and Spector (2001) showed that work performance is strongly related to procedural justice but only marginally to distributive and interactional justice.

In explaining this, they postulated that when rewards are distributed unfairly, people examine the process and procedure to see if it was fair before making a decision about how to respond. Cohen-Charash and Spector (2001) also found that procedural and distributive justice are related to organisational citizenship behaviour such as conscientiousness, altruism, commitment, engagement, loyalty, willingness to go the extra mile, willingness to give discretionary effort and intention to quit. They also found that all types of justice are related to job satisfaction and levels of trust but that

organisational commitment and counterproductive behaviours such as withdrawal, reduced effort, aggression/anger, theft, sabotage, selfishness and retribution were was more strongly related to procedural justice than to distributive and interactional justice. Simons and Robertson (2003) show how it is not only individual perceptions of justice that influence organisational outcomes but aggregated group perceptions. They found that if more than one person feels aggrieved then effects on organisational outcomes can be magnified by as much as 10%. Collet (2008) found that perceptions of procedural justice influence a whole range of attitudinal emotions which include feelings of being respected, loyalty and identification with companies, levels of trust in a company and commitment, engagement and cooperation. Other attitudinal (affective) reactions associated with perceptions of justice have been found to include: job dis-satisfaction; de-motivation; increased suspicion; reduced respect for others; reduced self-esteem/respect and; stress and hostility. Finally, Suliman (2007) shows how distributive justice can influence levels of efficiency and productivity and disputes, and Dayan and Benedetto (2007) found that interactional justice affects teamwork which in turn affects a person's willingness to contribute to an organisation.

METHOD

Using the theories of organisational justice outlined above an anonymous on-line self-report survey was undertaken to investigate the constituents of and dimensions of fairness in construction and examine how each dimension of fairness affects the behaviour of project stakeholders and how this translates to overall project performance. The population for the survey was the entire construction supply chain in Australia and New Zealand and the sample frame was provided by our industry partner (BCI http://www.bciaustralia.com/) who distributed the survey, using random sampling to targeted senior managers in their extensive data base of companies from across the construction supply chain. An online survey was used because it afforded anonymity to our respondents, because of the potential sensitivity of the data collected (fairness), because our respondents were senior managers who work extensively on line and because of the geographically distributed nature of the sample frame from across Australia and New Zealand.

The survey comprised three sections, where respondents were firstly requested to provide general information about their current job title, company's annual turnover, and the type of construction work they had worked on last project and its value. They were also asked to rate 51 statements reflecting their perceptions of fairness, their behaviour (organisational citizenship and positive and negative affectivity) and experience on their last project and to rate its overall performance, based on a seven-point Likert Scale '1 (strongly disagree/ very low) to 7 (strongly agree/ very high)'. According to Dawes (2007), a seven-point scale has a higher scale reliability and validity than those with fewer scale points, while more finely graded scales (for example, 9-point and 10-point scales) do not improve reliability and validity further. In this study, the analytical procedures proposed by Lim *et al.* (2011) and (2012) were adopted.

Exploratory factor analysis was firstly conducted towards exploring the pattern of relationships between measurements and their corresponding constructs and thus assesses the dimensionality of blocks of measurements within their corresponding constructs. Therefore the composition of the individual constructs were confirmed by the confirmatory factor analysis on the basis of the t-statistics generated for the individual measurements. We focussed on the respondent's last project to minimise

recall error and although we recognise that this may have been a good or bad project, this approach enabled random sampling of projects by avoiding them self-selecting projects that were good or bad for any particular reason. Generally, there is a tendency for people to recall bad experiences more easily than good experiences (negativity bias), so our results would have been negatively biased if we had allowed self-selection. See Table 1 for how these dimensions were operationalised in the survey by combining various measures from the literature. In the last section, respondents were also given an opportunity to share any examples of unfair treatment that their company had encountered on past projects. The questionnaire was pilot tested and refined before an industry-wide survey was conducted from a targeted stratified sample of architects, contractors, consultants, subcontractors and suppliers.

135 valid responses were collected. Sixty-seven (50%) of the 135 respondents were senior management (owner, CEO, directors), 49 (35%) were middle management (e.g. general managers, state managers and senior project managers) and the rest were from operational level (e.g. estimators, surveyors and contract administrators). Also, the majority of the respondents' companies (approx. 70%) had an annual turnover ranging from $1-50 million, and the rest with a turnover of more than $50 million. Most of our respondents were engaged as subcontractors (approx. 41%) and trade consultants (approx. 25%) in their last project, and the rest were main contractors (23%), suppliers (22%) and developers (3%). It is notable that no Architects responded.

DATA ANALYSIS

A successive 'classical-then-contemporary' validation approach was adopted in this study whereby all measurement items must successfully satisfy the criteria set for the classical validation process before going into the contemporary validation process. The former process involved the Cronbach's alpha test and exploratory factor analysis (EFA), while the latter comprised the confirmatory factor analysis (CFA) and square-rooted AVE score test. Of these, the CFA is considered as the first stage of the PLS-SEM modelling approach. The main purposes of conducting EFA followed by CFA was that the EFA could first help examining the relationships between the measurement items and their respective constructs (summarised in Table 1), and establishing the dimensionality of individual constructs.

Valid measurement items were then used for the CFA, to further validate the uni-dimensionality of respective constructs with inferential statistics. Partial Least Square (PLS)-Structural Equation Modelling (SEM) approach was chosen in this study for modelling the relationships among fairness dimensions, employee affectivity, organisational citizenship and project performance. The justifications for using the PLS-SEM approach over the covariance-based SEM approach are: (1) it is more oriented towards predictive application and best used for the exploratory nature of this study (Joreskog and Wold 1982); (2) it can analyse a more complex model than the latter, without requiring a large sample size (30 -100 datasets) and rigorous restrictions on data distribution (Fornell and Bookstein 1982); and (3) it tends to estimate constructs as linear combinations of observed variables using weight relations, thus avoiding the indeterminacy and providing an exact definition of constructs' scores (Chin 1998).

Also, in this study, several guidelines were adopted to endorse the item reliability and construct validity: (1) factor loading must be at least 0.55 (Comrey 1973) and significant at $p < 0.05$ (Anderson and Gerbing 1988); (2) Cronbach's alpha coefficient

must be at least 0.70 (Nunnally 1978); (3) composite reliability score must be at least 0.70 (Hair *et al.* 1998); and (4) average variance extracted (AVE) value must be at least 0.50 and the square-rooted AVE scores of respective pair of constructs must be greater than their correlation coefficients (Fornell and Larker 1981).

DISCUSSION OF RESULTS

The results are shown in Table 1 and show that all measurement items of respective constructs are reliable and valid, characterized by: their significant factor loadings (ranging from 0.71 to 0.950 at $p < 0.05$); their composite reliability scores of greater than 0.70 (ranging from 0.90 to 0.97); and their AVE scores of greater than 0.50 (ranging from 0.69 to 0.82). All these provide a great level of confidence in the reliability of the measurement obtained. The results in Table 1 reveal that fairness in construction is a multi-dimensional concept, comprising: (1) distributive and procedural (DPF); (2) interpersonal (IPF); and (3) informational (IMF). With regard to the first dimension 'DPF', this study found that dimensions of distributive and procedural fairness which are distinct in mainstream theory are not so in a construction project context. This is an important and new theoretical insight which suggests that mainstream justice theory might not be as transportable into a construction context as previous researchers, reviewed in earlier sections, have suggested. Nevertheless, these findings are in line with those of Tyler (2000) who found that procedural and distributive fairness are highly related because people will evaluate the extent of fairness in procedures based on the outcome they received. For example, if subcontractors receive a reasonably good outcome for their work done, they will perceive the procedure as fair and vice versa.

Turning to the second dimension 'interpersonal fairness (IPF)', it can be seen from Table 1 that nine (i.e. F1 – F9) out of the proposed 10 measurement items are found to significantly characterise IPF (with significant factor loadings ranging from 0.709 to 0.914), while item F10 is found to have a significant factor loading on the 'informational fairness (IMF)' dimension, rather than IPF. This shows that project stakeholders perceive and evaluate interpersonal fairness based on a set of considerations involving individual and collective treatments, such as the quality of relationship among relevant parties (F5), the freedom of association and expression (i.e. F6 and F7) and level of politeness (F1), dignity (F2) and respect (F3) respect for people's opinion (F4), health, safety (F8) and dignity and rights (F9). This finding supports those of Cameron and Green (2004), highlighting that it is important for decision-makers to effectively deal with the emotion and behaviour of project stakeholders at both individual and collective levels.

The third dimension 'Informational Fairness (IMF)' was characterised by six measurement items (F10 – F15) with significant factor loadings ranging 0.853 to 0.947. The findings revealed that IMF is underpinned by a two-way open and transparent communication and information exchange (F11) where stakeholders are expected to be informed and consulted of the major decisions that affects their interest (F12 and F15), and having the decisions being explained to them (F14), as well as being given adequate information for their task performance (F13). Thereafter, they should be given adequate say to negotiate or challenge the decisions made (F10).

Table 1 Factor analysis results of measurement items

Constructs and their corresponding measurement Items	(1)	(2)	(3)
Distributive and procedural fairness (DPF) [α=0.96; CR = 0.97; AVE = 0.74]			

Constructs and their corresponding measurement Items	(1)	(2)	(3)
We were rewarded fairly for the work that we did (F16)	0.71	0.87	40.11
#The risks we were asked to take were fair and commensurate with our ability to manage them (F17)	(0.41)		
We had opportunities to share in the rewards from any improvements we brought into the project (F18)	0.66	0.74	13.26
#We were resourced adequately to do our job effectively (F19)	(0.18)		
Contracts were fair and equitable (F20)	0.60	0.82	23.18
Our rewards were commensurate with our inputs, effort, ability and experience (F21)	0.78	0.87	36.66
#Disputes were resolved fairly (F22)	(0.52)		
The processes by which risks and rewards were distributed on our last project were fair (F23)	0.83	0.95	84.96
The processes by which risks and rewards were distributed on our last project were consistent (F24)	0.74	0.72	11.51
The processes by which risks and rewards were distributed on our last project were based on accurate information (F25)	0.79	0.91	47.20
The processes by which risks and rewards were distributed on our last project were negotiable (F26)	0.76	0.85	25.48
The processes by which risks and rewards were distributed on our last project were ethical (F27)	0.80	0.93	70.60
The processes by which risks and rewards were distributed on our last project were transparent (F28)	0.72	0.90	45.88
The processes by which risks and rewards were distributed on our last project were clear (F29)	0.73	0.90	32.06
Interpersonal Fairness (IPF) [α=0.94; CR = 0.95; AVE = 0.69]			
We were treated with politeness (F1)	0.75	0.87	37.38
We were treated with dignity (F2)	0.81	0.91	50.62
We were treated with general respect (F3)	0.75	0.91	62.94
Our opinions were valued (F4)	0.60	0.80	26.81
We had a good relationship with our client (F5)	0.68	0.85	30.30
We had freedom of expression (F6)	0.62	0.81	23.46
We had freedom of association (F7)	0.69	0.79	21.53
There was respect for people's health and safety (F8)	0.73	0.71	14.91
There was respect for people's dignity and rights (F9)	0.73	0.82	27.48
Informational Fairness (IMF) [α =0.96; CR = 0.97; AVE = 0.82]			
Communications were open and transparent (F11)	0.65	0.85	33.20
We were kept informed about major decisions that affected our interests (F12)	0.77	0.93	57.58
We were given adequate information to be able to undertake our jobs effectively (F13)	0.75	0.87	33.82
Decisions that affected us were explained to us (F14)	0.77	0.93	65.98
We were consulted about decisions that affected our interests (F15)	0.75	0.93	76.32
We had an adequate say (F10)	0.64	0.91	49.37
Organisational Citizenship Behaviour (OCB) [α= 0.93; CR = 0.95; AVE = 0.79]			
Conscientiousness (B13	0.79	0.88	27.94
Commitment (B14)	0.86	0.92	53.16
Engagement (B15)	0.70	0.91	49.05
Discretionary/voluntary effort (B16)	0.76	0.87	32.92
Loyalty (B17)	0.69	0.84	28.25

Constructs and their corresponding measurement Items	(1)	(2)	(3)
Positive Affectivity (PA) [α= 0.96; CR = 0.96; AVE = 0.77]			
Harmony (B1)	0.78	0.89	43.16
Morale (B2)	0.76	0.90	52.96
Respect for others (B3)	0.67	0.82	21.99
Honesty (B4)	0.80	0.87	37.47
Satisfaction (B5)	0.84	0.90	50.84
Motivation (B6)	0.75	0.85	26.21
Trust (B7)	0.87	0.90	51.42
Self-esteem (B8)	0.80	0.87	39.12
Negative Affectivity (NA) [α= 0.86 CR = 0.94; AVE = 0.71]			
Anger (B9)	0.69	0.76	7.62
Frustration (B10)	0.90	0.87	14.58
Hostility (B11)	0.89	0.91	28.56
Stress (B12)	0.83	0.81	15.09
Project Performance (PP) [α= 0.80; CR = 0.90; AVE = 0.70]			
Productivity (P1)	0.76	0.85	27.62
Safety Performance (P2)	0.75	0.71	12.75
Communication (P3)	0.62	0.89	37.48
Teamwork Performance (P4)	0.57	0.88	46.02

α = Cronbach's alpha score generated in SPSS; CR = Composite reliability; AVE = Average variance extracted. # Three out of the 51 measurement items which had factor loadings < 0.55 were removed (denoted by # in Table 1) so as to improve the confidence of reliability and validity of individual single- and multi-dimensional constructs. Column (1) = factor loadings generated by Exploratory Factor Analysis using SPSS. Column (2) = factor loadings generated by Confirmatory Factor Analysis using SmartPLS. Column (3) = t-statistics

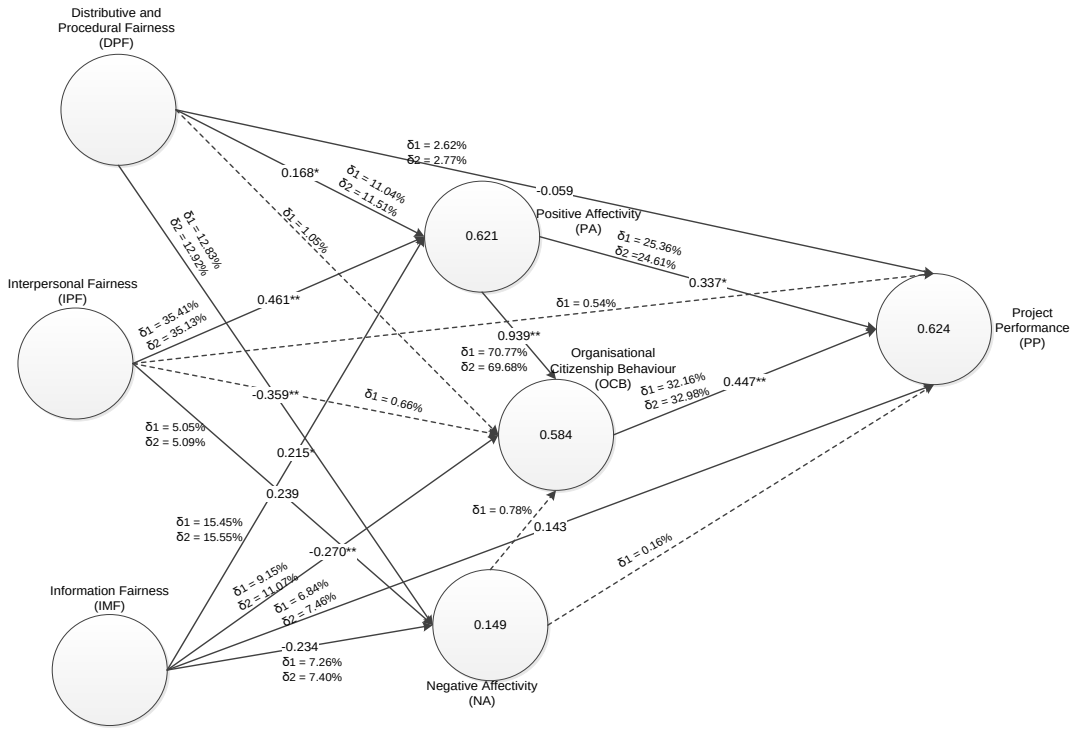


Figure 1 Structural model of fairness and project performance

Figure 1 summarises the significant relationships between distribution-procedural fairness (DPF), interpersonal fairness (IPF), informational fairness (IMF), positive affectivity (PA), negative affectivity (NA), organisational citizenship behaviour (OCB) and project performance (PP). Figure 1 shows that PA and NA are

significantly influenced by DPF, IMF and IPF. It also shows that it is the quality of interpersonal relationship (rather than processes and procedures) that is the major factor shaping people's motivation to perform on a project. Nevertheless, it was also found that DPF is a significant determinant of both positive (PA) and negative affectivity (NA), with the corresponding coefficients of 0.168 and -0.359 showing that DPF is more of a hygiene factor than a motivator since it reduces demotivation more than it increases motivational factors. It also shows that project participants are more likely to be negatively affected (i.e. becoming angry, frustrated, hostile and stressed), by DFP than by IPF and IMF.

Figure 1 also shows that the positive affectivity of individuals is the key factor shaping their organizational citizenship behaviour. However, Figure 1 also shows that IMF was found to have negative impact on OCB ($\beta = -0.270$), while at the same time, have positive influence on PA ($\beta = 0.215$). Why IMF and OCB are negatively correlated is unclear and further research is needed to explore this further.

Lastly, this study established that positive affectivity of individuals (PA; $\beta= 0.337$) and their organisational citizenship behaviour (OCB; $\beta= 0.447$) are key factors influencing overall project performance (PP). The findings reveal that OCB has a greater impact on PP than PA; however PA has both direct and indirect impacts on PP. For example, on the one hand, when individuals feel positively about the work environment then they will likely engage in behaviour which could contribute positively to project performance (as depicted by the relationship from PA → PP in Figure 1). Alternatively, positive affectivity can also act on project performance by beneficially affecting teamwork (a very strong relationship) and other citizenship behaviours, a much stronger effect that the direct impact of PA on PP.

CONCLUSIONS

The aim of this research was to examine how fairness affects project performance and we note in making our conclusion the cultural specify of this research and the possibility that our results may differ in different countries. Using theories of organisational justice the findings show that construction fairness is categorised into three dimensions: (1) Distributive and Procedural Fairness; (2) Interpersonal Fairness; and (3) Information Fairness. Using Structural Equation Modelling, a theoretical model is presented of how fairness acts on project performance through negative and positive affectivity and through organisational citizenship behaviour. While all dimensions affect outcomes in some way, the strongest path by which fairness affects project outcomes is through interpersonal fairness effecting positive affectivity, citizenship behaviour and in-turn project performance. Our results suggest that it is therefore the nature of interpersonal relationships rather than the way risks and rewards are distributed that is most important to project success. However, the research findings need to be interpreted within the limitations of this study which is exploratory in nature; especially since the majority of measurement items of the respective constructs were borrowed from cross-discipline studies and then re-contextualized into construction. Likewise, a relatively small sample size of 135 had been used to develop the predictive model. Thus, it is acknowledged that the research findings are indicative but not conclusive.

ACKNOWLEDGEMENTS

The authors acknowledge and thank BCI for their assistance with this research.

REFERENCES

Aibinu, A A, Ling, F Y Y and Ofori, G (2011) Structural equation modelling of organizational justice and cooperative behaviour in construction project claims process: contractor's perspective. *Construction Management and Economics*, **29**(5), 463-481.

Anderson, J C and Gerbing, D W (1988) Structural equation modelling in practice: a review and recommended two-step approach, *Psychological Bulletin*, **103**(3), 411-423.

Cameron, E and Green, M (2004) *Making Sense of Change Management.* London: Kogan Page.

Chin, W W (1998) The partial least squares approach to structural equation modelling. *In*: G A Marcoulides (Ed.) *Modern Methods for Business Research*. New Jersey: Erlbaum Publishing, 295-335.

Choi, A and Rainey, H G (2013) Organizational fairness and diversity management in public organizations: does fairness matter in managing diversity? *Review of Public Personnel Administration*, **20**, 9-22.

Cohen-Charash, Y and Spector, P E (2001) The role of justice in organizations: A meta-analysis. *Organisational Behaviour and Human Decision Processes*, **86**(2), 278-321.

Collet, J L (2008) Is procedural justice enough? Affect, attribution and conflict in alternative dispute resolution. *Advances in Group Processes*, **25**, 267-289.

Comrey, A L (1973) *A First Course in Factor Analysis*. New York: Academic Press.

Cropanzano, R, Byrne, Z S, Bobocel, D R and Rupp, D E (2001) Moral virtues, fairness heuristics, social entities and other denizens of organizational justice. *Journal of Vocational Behaviour*, **58**(2), 164-209.

Dawes, J. (2007) Do data characteristics change according to the number of scale points used? An experiment using 5-point, 7-point and 10-point scales. *International Journal of Market Research*, **50**(1), 61-78.

Dayan, M and Benedetto, A D (2007) Procedural; and interactional justice perceptions and teamwork quality. *Journal of Industrial and Business Marketing*, **23**(8), 566-576.

Egan, J Sir (1998) *Rethinking Construction*. London: Department of Trade and Industry.

Emmerson, H Sir (1962) *Survey of Problems before the Construction Industries*. London: HMSO.

Falk, R F and Miller, N B (1992) *A Primer for Soft Modelling*. Ohio: University of Akron Press.

Fornell, C and Bookstein, F L (1982) Two structural equation models: LISREL and PLS applied to consumer exit-voice theory, *Journal of Marketing Research*. **19**(4), 440-452.

Fornell, C and Larcker, D F (1981) Evaluating structural equation models with unobserved variables and measurement error. *Journal of Marketing Research*, **18**(1), 39-50.

Hair, J F, Anderson, R E, Tatham, R L, and Black, W C (1998) *Multivariate Data Analysis with Readings*, (International Edition). New Jersey: Prentice Hill.

Joreskog, K G and Wold, H (1982) The ML and PLS technique for modelling with latent variables: Historical and comparative aspects. *In*: K G Joreskog and H Wold (Eds.) *System under Indirect Observation: Causality, Structure, Prediction - Part 1*. Amsterdam: North Holland, 263-270.

Kadefors, A (2005) Fairness in interorganizational project relations: norms and strategies. *Construction Management and Economics*. **23**(80), 871-878.

Luo, Y (2007) The interdependent and interactive roles of procedural, distributive and interactional justice in strategic Alliances. *The Academy of Management Journal*, **50**(3), 644- 664.

Latham, M Sir (1994) *Constructing the Team*. London: HMSO.

Lim, B T H, Ling, F Y Y, Ibbs, C. W., Raphael, B., Ofori, G., 2012. Mathematical models for predicting organizational flexibility of construction firms in Singapore. *Journal of Construction Engineering and Management*, **138**(3), 361-375.

N.E.D.O. (1983) *Faster building for industry*. National Economic Development Office, HMSO, London: Mill Bank.

Nunnally, J C (1978) *Psychometric Theory*. 2nd Edition. McGraw-Hill, New York.

Raidén, A B and Sempik, A (2013) Illusions of equity, procedural justice and consistency: a critique of people resourcing 'best practice' in construction organisations. *In*: A R J Dainty and M Loosemore (Eds.) *Human Resource Management In Construction: Critical Perspectives*. London: Routledge, 226-252.

R.C.B.C.I. (1992) *Final Report by RV Gyles QC, Vols. 1-10*. Royal Commission into Productivity in the Building Industry in NSW.

R.C.B.C.I. (2002) *Final Report, Royal Commission into the Building and Construction Industry*. Melbourne Victoria, Australia.

Ringle, C M, Wende, S and Will, A (2005) *SmartPLS 2.0 (beta).* University of Hamburg, Germany, < www.smartpls.de>

Simons, T and Roberson, Q (2003) Why managers should care about fairness: the effects of aggregate justice perceptions on organisational outcomes. *Journal of applied psychology*, **88**(3), 432-443.

Suliman, A M T (2007) Links between justice, satisfaction and performance in the workplace. *Journal of Management Development*, **26**(4), 294-311.

Thibaut, J and Walker, I (1975) *Procedural; justice: a psychological analysis*. New Jersey: Erlbaum Publishing.

Tyler, T (2000) Social justice: Outcome and procedure. *International Journal of Psychology*, 35(2), 117-125.

Tyler, T and Bies, R J (1990) Beyond formal procedural: the interpersonal context of procedural justice. *In*: J Carroll (Eds.) *Applied Social Psychology and Organizational Settings*. New Jersey: Erlbaum Publishing, 77- 98.

Wolstenholme A (2009) *Never Waste a Good Crisis*. London: Constructing Excellence.

PROJECTS AND COLLABORATION

UNDERSTANDING THE DRIVERS AND NEEDS FOR MEGA INFRASTRUCTURE PROJECT DEVELOPMENT IN SAUDI ARABIA

Faisal Alsedairy[1] and Simon D Smith

School of Engineering, University of Edinburgh, William Rankine Building, King's Buildings, Mayfield Road, Edinburgh, EH9 3JL, UK

Mega infrastructure projects (MIP) are continuously complicated along their lifespan. Whether in their planning or execution stages, they are highly diverse from one another and require different approaches for their planning and decision-making. The Saudi infrastructure sector is booming and many projects can be classified as Megaprojects. That is, they come with a minimum life span of fifty years and a starting price that exceeds GBP 1 Billion. The current investment for infrastructure in the Kingdom of Saudi Arabia is about GBP 100 Billion per annum. In order to provide contextual knowledge for scholars decision makers, this paper explains the goals, agendas and forces driving MIP development in the specific context of the Kingdom of Saudi Arabia. In order to understand more and rank these drivers, Multi Criteria Analysis will be used in combination with data gathered from two sources: firstly, knowledge (gathered from questionnaire data) from a pool of the Saudi Council of Ministers and the Bureau of Experts – the 'Shura Council' or the Consultative Assembly of Saudi Arabia. Secondly a historical analysis of Saudi's five-year plan goals and objectives from 1970-2019 is used in order to understand and track the development priorities of the nation. Results suggest that as well as societal and economic drivers, the religious values are significantly important, expressed by the need to safeguard and uphold Islamic values.

Keywords: Decision Analysis, economic development, Mega Infrastructure Projects, Saudi Arabia.

INTRODUCTION

Mega infrastructure projects (MIPs) are significant developments that exceed the relative norm of infrastructure projects. Dimitriou (2009), in a consideration of privately financed mega transport projects, explains that within a description of an infrastructure project, the word "mega" refers to a significant increase in its size, budget, lifespan, complexity and uncertainty. MIPs are known for their high complexity, risks and uncertainty. They exceed a fifty-year lifespan and a billion pound budget (Bruzelius *et al*., 2002). Graham and Marvin (2001) argue that progress and development cannot unfold without the presence of MIPs. Flyvbjerg *et al*., (2003) refers to MIPs as political animals that feed on a country's resource. Their financial and social stakes are so large that they can endanger the survival of corporations or threaten the economic stability of the countries involved (Eweje *et al.*, 2012).

[1] F.S.Alsedairy@sms.ed.ac.uk

Alsedairy, F and Smith, S D (2016) Understanding the Drivers and Needs for Mega Infrastructure Project Development in Saudi Arabia. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference,* 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 793-802.

MIPs make great impacts and clearly need to be planned and designed on a rational basis. They are constantly developed for political, economic, social or environmental reasons. Despite their growing popularity, MIPs often fail to meet cost estimations, project objectives and time schedules (Marrewijk *et al*., 2008). Cost escalations within MIPs happen in almost nine out of ten projects with an average cost increase of 28 percent on average (Giezen, 2012). Flyvbjerg (2003) found that cost overruns of 50-100% in fixed prices are common for MIPs. Budget overruns and lower effectiveness has led researchers (e.g. Altshuler and Luberoff, 2004) to question the rationale and the sustainability of MIPs.

Allport (2011) and Williams and Samset (2010) have argued that a significant part of an MIP's success is achieving effectiveness through the delivery of its strategic intention which was based on policies that give birth to such projects. MIP success, therefore, is not merely based upon time, budget and quality, which are usually referred to as "the iron triangle", but rather success is based upon the achieved public policy.

Contextual information is a key factor in successful decision-making. Being aware of the context in which a project is developed is a constructive way to address the risks, uncertainties and complexities that characterize MIPs (Dimitriou *et al*., 2012). Zhi (1995) notes that each project has its own unique risk and organisational context that influence the strategic approach on the intended MIP. Contextual influences can even affect the rationale behind the project and what constitutes as success (Dimitriou *et al*., 2013).

This paper aims to better understand the goals and visions driving MIP development in the context of Saudi Arabia. For an MIP strategy to be effective, it must have a vision and address both 'manifestation' and 'root problems' and the need of strategies to reflect these dynamics and influenced by them as driving forces. (Dimitriou *et al*., 2013). Key project stakeholders need to identify and analyse the context surrounding MIP decision-making (Dimitriou *et al*., 2012). In a study of the power of context on Asia's MIP scene, Dimitriou (2006) explains that effective problem solving has appreciation for the context surrounding the problems.

Knowing and understanding the context's agenda and leading goals will therefore help develop further research the Saudi context, a pre-step necessary before any decision process is formed. The paper aims to dwell into the Saudi context in regard to MIPs. It will consider the Saudi Five-Year plans which include the goals, projects and programmes that needs to be developed. If it is considered, as Eweje *et al*., (2012) adds, that MIPs are programmes that integrate strategically-aligned projects into one very large project then from this perspective, we can view the Five-Year Plan as an MIP. We can argue on the current success of Saudi Five-Year Plan in relation to its policy effectiveness. Analysis of the Five-Year Plan offers the vision and priority goals of the Saudi context and who can that have an effect on future research of MIP planning and decision making within the Saudi context.

CONTEXTUAL SETTING: SAUDI ARABIA

This research outlined in this paper ventures into the context of Saudi Arabia, one of the wealthiest nations in the world. With 264 billion barrels the Kingdom has the world's second largest oil reserve after Venezuela, a proportion of approximately 16%. It also has the largest production capacity in the world and pumps just under 12 million barrels per day (EIA, 2014). The country is highly dependent on this unique

natural resource as the oil industry produces 75% of state revenues. Rahman and Khondaker (2012) note that oil export revenues account for around 90% of total Saudi export earnings and 75% of the state's overall revenue.

Saudi Arabia hasn't always been a wealthy nation. According to the Ministry of Planning (2015), the nation was economically poor before 1948, when 90 percent of the population were either nomads or farmers. Between 1948 and 1952, the country saw a change in what it considers the early innovation period and a turning point for the country. The country prepared its first formal budget in 1948. Revenues started to build, basic infrastructures developed, and modern port facilities were completed in Jeddah. In 1951, Saudi Arabia conducted its first major MIP, the Dammam-Riyadh railway, a 52 million USD project, even though it was considered a costly investment (at the time, oil revenue was about 50 million dollars per year).

Early development occurred during the period between 1952 and 1970, which helped the Saudi GDP grow at an annual rate of 10.6%. By 1970, rapidly developing infrastructures caused an emergence of substantial metropolitan centres in Riyadh, Jeddah, Dammam, Mecca, Medina, and Hofuf (Ministry of Planning, 2015).

Until 1970, institutional expansion, mainly focussing on health, education, and physical infrastructure, followed the growth of the oil revenues (Ministry of Planning, 2015). After 1970, King Faisal initiated a series of Five-Year Plans. Sicherman (2011) notes that these plans were primarily focused and intended for Saudi Arabia's economy; the objective was to provide the government with the tools to become a modern technological society while maintaining the religious morals that underpinned its legitimacy. By 2015, however, as Fattouh and Sen (2015) explain, the Kingdom faces key issues, in particular dependency on depleting oil reserves in a destabilised geographic location.

METHODS

The paper uses two sets of data to understand the goals and visions driving Saudi's MIP development. The first set includes 28 questionnaires completed by members of the Regulative and Executive Authority (of the 183 total members, 33 sit on the Council of Ministers and 150 on the Shura Council). The questionnaires were requested respondents to score the ninth Five-Year Plan goals from 1 to 10. 23 of the respondents were from pre-selected Shura Members, and the remaining 5 from pre-selected Council of Ministers. The pre-selecting method offered a way to approach the difficulty of access to participants who serve on the councils. The second set of data are the Five-Year Plans "goals" in their various iterations since their beginning in 1970 until the ninth plan in 2014.

Table 1 shows the vehicle in which data are considered. The analysis will adopt a Multi-Criteria Analysis framework, an example of which is shown in Table 2. It is to be noted that MCA is based on uncovering the potential of success or not. It is a decision-making tool to aid decision makers. This is not the primary concern of the research; rather it is focused on uncovering development priorities. Thus the "Impact of Assessment" score in Table 2 is replaced by "Historical Occurrence" as illustrated in Table 1. Historical occurrence is the frequency of repetition of a goal along the Five-Year Plans studied.

The framework will conclude with a ranking of the Saudi leading goals that are taken from the Ninth Development Plan (2009-2014). Those that are ranked highest will be measured for success through collected data and further literature. The results will

facilitate a discussion on the contextual aspects of the Kingdom and provide contextual depth for the Kingdom of Saudi Arabia.

ANALYSIS AND RESULTS

As shown in Table 1, the framework consists of five columns: the ninth Five-Year Plan goals; the average weighting of each goal as measured by the questionnaire; the historical occurrence of each goal; the score of each goal, produced by multiplying the average weight with the historical occurrence; and finally, each goals ranking.

Table 1: An example of the study framework

Five-Year Plan goals	Weight (1-10)	Historical occurrence (0-8)	Score	Ranking
Goal I	10	5	50	B
Goal II	10	2	20	D
Goal III	9	4	36	B

Table 2: A typical MCA framework

Goals	Weight (1-10)	Impact of Assessment	Score	Ranking
Goal I	10	5	50	B
Goal II	10	2	20	D
Goal III	9	4	36	B

The aim of the ranking is to uncover priorities of the context. While all goals and objectives are interesting, this paper will focus on only high priority goals, ranked A, B or C. The historical occurrence will help correct any errors with the questionnaire. It will solidify the results of the questionnaires by including their impact on the final scoring. Because the Five-Year Plans were initiated in 1970, they provide an opportunity to track government goals for a period of more than forty years, which allows the researcher to trace each goal back to the first Five-Year Plan. The more they dwell further back, the more they gain priority and offer the opportunity to uncover root issues. Nevertheless, contexts exist in a cycle that changes depending on multiple inputs and outputs. Thus, a historical tracking of the goals is only a start.

The ranking system is shown in Table 3.

Table 3: Ranking system

Score	Ranking
55 and above	A
35-54	B
25-34	C
15-24	D
14 and below	E

Questionnaires were administered between January and March 2016 to address current concerns. Combining current weighting of goals with historical occurrence will produce a more accurate representation of contextual priorities than either of these factors taken individually. These two entities complement each other and offer a more accurate representation of reality than analysing either independently.

This paper does not select the Tenth Plan (2015-2019) as a focus of the research for two reasons. Firstly, the Tenth Plan has been put on hold. The Ministry of Planning did not release the final document and is subject to change. Secondly, if chosen for this study, the Tenth Five-Year Plan would make it impossible to measure priority goals and achievements until post 2019, which would set back this research because the study aims not only to uncover the goals and drivers of MIP development in Saudi Arabia, but also to better understand the Five-Year Plan current condition because the

Five-Year Plan is a powerful vehicle that carries the initiation of multiple MIPs. Table 4 shows the results of the questionnaire analysis.

Table 4: Results of the MCA Analysis on Questionnaire Returns

	Goals	Weight (1-10)	Historical occurrence (0-8)	Score	Ranking
1	To safeguard Islamic teachings and values, enhance national unity and security, guarantee human rights, maintain social stability and consolidate the Arab and Islamic identity of the Kingdom.	9.4	8	75.0	A
2	To continue to develop the holy places, and improve the services provided to Hajj and Umrah performers to ensure performance of religious rites easily and conveniently.	5.9	1	5.9	E
3	To achieve sustainable economic and social development by accelerating the rate of economic growth and social welfare.	7.1	1	7.1	E
4	To achieve balanced development among regions of the Kingdom	7.3	4	29.2	C
5	To enhance human development, expand the range of options open to individuals to enable them to acquire and use knowledge, skills and expertise, and provide appropriate healthcare services.	6.6	7	46.2	B
6	To raise the standard of living and improve the quality of life of all citizens.	5	4	20	D
7	To diversify the economic base horizontally and vertically, expand the absorptive and productive capacities of the national economy and enhance its competitiveness, and maximize the return on competitive advantages.	7.1	8	56.8	A
8	To move towards a knowledge-based economy and consolidate the basis of an information society.	5.2	1	5.2	E
9	To enhance the role of the private sector in socioeconomic and environmental development and expand domains of private investments (domestic and foreign) and public-private partnerships.	4.8	4	19.2	D
10	To develop, conserve and ensure rational utilization of natural resources, particularly water, protect the environment and develop environmental systems within the context of sustainable development.	4.7	1	4.7	E
11	To continue socioeconomic and institutional reform, develop regulations aimed at raising efficiency and improving performance, work towards entrenching transparency and accountability, and support civil-society institutions in advancing their developmental activities.	6.3	0	0	E
12	To strengthen economic integration with Gulf Cooperation Council and Arab states and develop relations with Islamic and friendly countries.	3.6	5	18	D
13	To develop the sector of Small and Medium Enterprises to increase its contribution to GDP, and create frameworks for nurturing and organizing it.	5	0	0	E

DISCUSSION: HIGH PRIORITY GOALS

Rank A

Safeguarding Islamic values and confirming Sharia play key roles in the political agenda and are highly visible throughout the Five-Year Plans. The Saudi people are generally conservative, and their religious figures heavily influence public opinion.

As Albassam observes (2015), for the last half-century, the Kingdom has been held together informally through a alliance between the government and the traditional religious leaders.

Because the Kingdom of Saudi Arabia is located in a tense region under constant conflict, defence and internal security are also important themes. Saudi Arabia borders two countries at war: Iraq in the north and Yemen in the south. While the commentary is now nearly twenty-five years old, the words of Tempest (1992) are still relevant to the security dilemma in the Middle East:

> As the superpowers disarm and dump increasingly sophisticated weapons and the rest of the world's arms manufacturers, stripped of traditional markets at home, now queue to be allowed to pour their product into the Middle East, the trickle is turning into a flood. Sooner or later, one country or another which sees the narrow comparative advantage will want to use the weapons

Thus, a significant percentage of the budget goes to defence capabilities. Figure 1, which shows each sector of the Saudi government's budget from 2002-13, illustrates that the majority of the budget goes to defence and security in answer to its goal of upholding security that comes with a huge cost, which clearly reflects the fragile state of the Middle East.

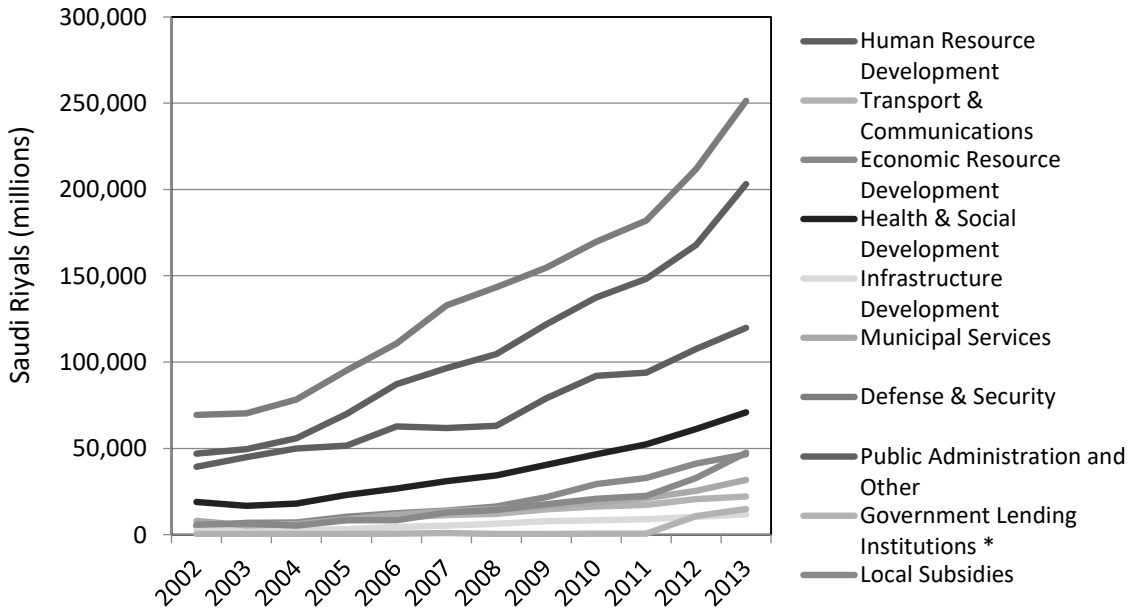


Figure 1: Saudi Arabia governmental budgets (2002-2013) (Source: Saudi Ministry of Finance, 2015)

Although it should have been delivered through the aid of economical MIPs, the kingdom has shown no progress reducing dependence on oil, diversifying the economy or developing a balanced growth.

Using iterations of the Five Years Plans since 1970, Albassam (2015) investigated whether the following objectives have advanced or not: oil as a percentage of GDP, private sector as a percentage of GDP, oil as a percentage of the country's exports, and oil revenues as a percentage of total government revenues—over nine Development Plans (1970–2013). He concludes that oil still dominates almost all the variables studied and this objective is a long way from being achieved.

Albassam (2015) further argues that that objective of diversifying is not functioning for several reasons: (1) the absence of a clear plan that details the process of diversifying, (2) the aided sector for economy diversification is mainly dependent on oil (petrochemical industries), (3) the private sector depends on government spending and projects, and (4) the lack of a clear and specific plan on supporting non-oil sectors (e.g., agriculture, service). He raises the possibility of a link between resource curse theory and Saudi Arabia:

> Conversely, many countries that draw a high percentage of their national income from a natural resource fall into what is known as the "resource curse," where the country relies almost exclusively on that resource and does not make sufficient effort to diversify its income resources, which has a negative influence on its economic development

Albassam further adds that the private sector's dependence on government spending negatively affects the role that the private sector should play in diversifying the economy. Thus, economic diversification efforts by the Saudi government have shown little success in meeting the development plans' objectives. As noted by Farzin (1993) in considering the United Arab Emirates, rich oil countries rely heavily on oil, because it has become a comfortable source of income. That takes a toll on any economic diversification objective. Any fluctuation on the petroleum market – and of course this happens regularly - will jeopardize domestic investments by disrupting the revenue stream needed to finance them.

Rank B

It has been noted since the first Development Plan that a major issue is the demand for human resources; thus, there has been a high level of non-Saudi labour that the Saudi government has been trying to reduce. It is perhaps unsurprising therefore that developing human resource was ranked B and is considered very important to the Saudi government and this is expressed by a policy of reducing the difference between Saudi and non-Saudi employees. Unfortunately, while every plan aims to reduce that gap, data show that in 2006 non Saudi employees represented 54% of the whole, while in 2015, this proportion rose to 56% (Central department of statistics and information, 2016). This further showcases the lack of effectiveness the series the series of Five-Year Plans has had on accomplishing stated goals and highlights the need for further development.

Rank C

Balancing development in the Kingdom ranked (C). Albassam (2015) links this objective to diversifying the economy:

> Balanced development between urban and rural areas is recognized as one benefit of economic diversification. As many studies have shown, in less diversified economies, development and job creation tend to be concentrated in urban areas or near oil fields or mines and mineral processing plants.

In analyzing the determinants of the Arab Awakening, Costello *et al.*, (2015) invoke once again the ideas of resource or "oil curse" and argue that economic dependence on oil and natural gas production creates unemployment and major social disparities and inequalities, and these aspects might explain the country's unbalanced growth.

The issues of balanced growth is complex in the Saudi context. The economical engines in Saudi Arabia are split in three provinces with no mega transport infrastructure linking them to surrounding areas. The current engines are in the east, west and center. That growth in the center followed Riyadh the capital. Since the oil

fields are in the Eastern Provenance, this region houses the oil industry. The Western province is a very sensitive and important part of the country; it includes Mecca and Madinah (Medina), the holiest cities to every Muslim. Growth in the north and south is not consistent with the rate of growth in other provenience, and unbalanced growth has become a reality. A combination of developing economical engines covering the country in every provenance and linking them with transport MIPs would help spread growth in the country as whole. Transport MIPs can help provide economic growth to surrounding areas by connecting them to a city that holds an economic engine (Aguilar and Ward, 2003). Transport MIPs create a lucrative investment climate around them or foster improvements upon the investment climate. As observed in South Africa and Mozambique they even benefit the small investors in other sectors of the economy via their deliverable positive investment climate (Castel-Branco, 2004).

Saudi Arabia wasn't free from developing its basic infrastructure until the early 1980s (Ministry of Planning, 2015) and afterwards, the Gulf War coupled with oil market crashes exhausted its resources (Linderoth, 1992). Since then, it has focused on maximizing its revenue from its oil industry. As Fattouh and Sen (2015) assert, the petroleum industry ranks high in the country's agenda, and it is necessary to overcome huge debits due to budgets deficits in the 1980's and 90's. Nevertheless, the Kingdom should give concern for establishing more economical engines along its provinces and constructing Transport MIPs to spread growth to surrounding areas and balance growth.

CONCLUSIONS

Infrastructure development in Saudi Arabia has significant issues – the investment is in the region of GBP100 Billion per annum and the context in which the planning and development is undertaken has unique issues manifested in terms of political, religious, economic and cultural aspects.

In order to investigate these issues further, and as part of a wider research project considering decision making in Saudi infrastructure development, this paper aimed to understand the priority goals within the Saudi context and to uncover root issues that are interlinked or independent. The study, using consultations with key Saudi decision makers has affirmed the four top priority development goals: upholding Islamic values and the security of the Kingdom; diversifying the economy; developing human resources and balancing growth across the Kingdom.

This knowledge is essential for effective planning and delivery of Saudi infrastructure, many implementations being Mega Infrastructure Projects (MIPs). But the analysis has left us with what seems to be a major root issue: the Five-Year Plan. In its multiple iterations, the Five-Year Plan has shown low levels of success, and its selection of programmes and projects does not deliver some of its main goals. These are identified as: diversifying the economy, developing human resource and a balanced growth along the regions of the Kingdom. Almost fifty years since its first draft, the Five-Year Plans continue to yield low effectiveness and achievement of these polices, which the literature suggests are signs of unsuccessful MIPs. The formation of the Five-Year Plan needs to be investigated.

Saudi Arabia is troubled by a security dilemma and an economic engine that is quite fragile. Uncertainty is high due to a crash in the world market of oil prices and a war with its neighboring country Yemen. The tenth year plan that would cover from 2015 to 2019 has been put on hold, reflecting how bad the situation is. And yet the

economic progress of the country is interlinked with the progress and success of the Five-Year Plans. A key issue is the revision of the plans implementation due to fluctuations within the oil market. The paper recommends that any formation of a Five-Year Plan and its decision makers must consider this aspect.

REFERENCES

Aguilar, A G, Ward, P M and Smith Snr, C B (2003) Globalization, regional development and mega-city expansion in Latin America: Analyzing Mexico City's peri-urban hinterland. *Cities*, **20**(1), 3-21.

Albassam, B A (2015) Economic diversification in Saudi Arabia: Myth or reality? *Resources Policy*, **44**, 112-117.

Allport, R J (2011) *Planning Major Projects*. London: Thomas Telford Ltd.

Alriyadh (2016)http://www.aleqt.com/2016/01/31/article_1026342.html (Accessed June, 2016)

Altshuler, A A and Luberoff, D E (2004) *Mega-projects: The changing politics of urban public investment*. Washington D C: Brookings Institution Press.

Bruzelius, N, Flyvbjerg, B and Rothengatter, W (2002) Big decisions, big risks: Improving accountability in mega projects. *Transport Policy*, **9**(2), 143-154.

Costello, M, Jenkins, J C and Aly, H (2015) Bread, Justice, or Opportunity? The Determinants of the Arab Awakening Protests. *World Development*, **67**, 90-100.

Dimitriou, H (1983) Urban mobility and sustainability in Asia and the power of context. *Transportation Research Record: Journal of the Transportation Research Board*, 140-150.

Dimitriou, H T, Ward, E J, and Wright, P G (2013) Mega transport projects-Beyond the 'iron triangle': Findings from the OMEGA research programme. *Progress in planning*, **86**, 1-43.

Dimitriou, H T (2009) Globalization, mega transport projects and private finance. *In*: *4th International Conference on Future Urban Transport, Göteborg, Sweden*, April 19th-21st.

Dimitriou, H T, Ward, E J and Wright, P G (2012) *Mega Projects Executive Summary Lessons for Decision-maker: An Analysis of Selected International Large-Scale Transport Infrastructure Projects*, London: OMEGA Project 2, OMEGA Centre and VREF, University College London.

Dimitriou, H T, Harman, R and Ward, E J (2010) *Incorporating Principles of Sustainable Development within the Design and Delivery of Major Projects: An international study with particular reference to Major Infrastructure Projects*. London: OMEGA Centre, University College London.

EIA (2014) *US Energy Information Administration, Country Analysis Brief: Saudi Arabia*. http://www.eia.gov/beta/international/analysis_includes/countries_long/Saudi_Arabia/saudi_arabia.pdf (Accessed: April, 2016)

Eweje, J, Turner, R and Müller, R (2012) Maximizing strategic value from megaprojects: The influence of information-feed on decision-making by the project manager. *International Journal of Project Management*, **30**(6), 639-651.

Farzin, Y H (1993) Importance of foreign investment for the long run economic development of the United Arab Emirates. *World Development*, **21**(4), 509-521.

Fattouh, B and Sen, A (2015) *Saudi Arabia Oil Policy: More than Meets the Eye*. Oxford: The Oxford Institute for Energy Studies, June, 2015.

Flyvbjerg, B, Bruzelius, N and Rothengatter, W (2003) *Megaprojects and Risk: An Anatomy Of Ambition.* Cambridge University Press.

Giezen, M (2012) Keeping it simple: A case study into the advantages and disadvantages of reducing complexity in mega project planning. *International Journal of Project Management*, **30**(7), 781-790.

Graham, S and Marvin, S (2001) *Splintering Urbanism: Networked Infrastructures, Technological Mobilities and the Urban Condition*. Psychology Press, Routledge, London.

Linderoth, H (1992) Target revenue theory and Saudi Arabian oil policy. *Energy Policy*, **20**(11), 1078-1088.

Van Marrewijk, A (2007) Managing project culture: The case of Environ Megaproject *International Journal of Project Management*, **25**(3), 290-299.

Rahman, S M and Khondaker, A N (2012) Mitigation measures to reduce greenhouse gas emissions and enhance carbon capture and storage in Saudi Arabia. *Renewable and Sustainable Energy Reviews*, **16**(5), 2446-2460.

Saudi Central Department of Statistics and Information (2015) *Saudi Employees 2006 to 2015.*

Saudi Ministry of Finance (2015) *Government Budget Data Covering 2002-2013.*

Saudi Ministry of Planning (2015) *Saudi Arabia Five Year Plans (1-9).*

Sicherman, H (2011) King Fahd's Saudi Arabia. *Orbis*, **55**(3), 481-488.

Williams, T, and Samset, K (2010) Issues in front-end decision making on projects. *Project Management Journal*, **41**(2), 38-49.

Tempest, P (1992) Playing with Middle East fire: The global energy powder keg again on short fuse. *Energy Policy*, **20**(11), 1073-1076.

Zhi, H (1995) Risk management for overseas construction projects. *International Journal of Project Management*, **13**(4), 231-237.

THE IMPEDIMENTS TO EFFICIENT MEGAPROJECT IMPLEMENTATION IN SOUTH AFRICA

Nthatisi Khatleli[1]

School of Construction Economics and Management, University of the Witwatersrand, 1 Jan Smuts Avenue, Braamfontein 2000, Johannesburg, South Africa

The infrastructural backlog in South Africa has actualised several Megaprojects in diverse sectors to improve the country's economic competitiveness. However challenges faced by infrastructural Megaprojects implementation has resulted in bad publicity, widespread angst over their mounting costs, user indifference because of perceived government whitewash and a lack of a psychological contract with the general populace. The endemic challenges of restive labour force, the immature levels of business sophistication and institutional weaknesses have all conspired to make the implementation of these projects very inefficient and contestable. This study is based on two Megaprojects in South Africa which were implemented against the backdrop of the aforementioned impediments. The two projects of Gauteng Freeway Improvement Project (GFIP) and Medupi Power were chosen because they represent the two sectors that are predominant in the Megaprojects space in Africa. What the study found was that a rushed implementation of these projects always result in unsavoury repercussions, as a meaningful public participation process encompassing democratic principles has to first be implemented, there also has to be a certain level of dynamism in the national policies to avoid compromising the quality of the product.

Keywords: efficient, impediments, Megaprojects, South Africa, quality

INTRODUCTION

Mega projects have received considerable attention in recent years in theoretical literature, as one prominent strand associates them with global economic restructuring and rescaling (Kennedy *et al*., 2014). Mega projects attract widespread interest; controversy and publicity as their sheer size open them up to constant scrutiny. Their failures usually generate more attention than their successes and therefore most of them face an uphill task in gaining public acceptance and support (wolmar, 2013). Many mega projects have degenerated into mega disasters. Their size makes them intrinsically risky; this is because they are linked to a jumble of motivations and aims, some of which are in conflict (Mushni, 2014).

The interests and power relations involved in mega projects are typically strong given the sums of money involved, the many jobs, the environmental impacts and the national prestige. The idealistic communicative and deliberative approaches and evaluative yardsticks for decision making are therefore quite defenceless in the face of power (Flyvberg, 2003). Flyvbjerg (2003) argues that power play instead of commitment to deliberative ideals is characteristic of Megaproject development. The stakeholders do not always represent publics, and on democratic and pragmatic

[1] nthatisi.khatleli@wits.ac.za

Khatleli, N (2016) The Impediments to Efficient Megaproject Implementation in South Africa. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 803-812.

grounds the public is not properly involved in decision making. Thus the conventional decisionistic approach to project implementation has to be replaced by an institutionalistic approach that is centred on accountability (Babatunde *et al*., 2014). There is a growing fear that inequality in decision making processes will lead to unequal distribution of risks, burdens and benefits from project. The apparent 'democracy deficit' due to lack of involvement of civil society and opaque processes is currently bedevilling mega projects implementation. The general public is generally sceptical or negative towards these projects, this is demonstrated through hostile protestations and in some cases downright sabotage on these projects (Oliomogbe and Smith, 2012).

With the current problems at the energy power stations at Medupi (US$20.3) and Kusile (US$10.8), some are contending that South Africa is losing the ability to build Megaprojects. These two projects were implemented to meet the struggling energy infrastructure that could no longer cope with the growing needs of the economy. The Gauteng Freeway Improvement Project (GFIP) is another important transport project that was initiated in the Gauteng province to increase the flow of traffic. This is very important because Gauteng is the engine of the economy with a Gross Domestic Product (GDP) valued at R811 billion (US$72 billion), Gauteng generates 33.9% of the South African GDP and 10% of the total GDP of the entire African continent. Gauteng dominates the South African economy in every major sector except agriculture, mining and quarrying (Gauteng Government, 2016).

It is the strategic importance of these projects that has made them suitable to be used as cases in the discourse of the challenges in implementing mega projects in South Africa. The democratic deficit, occasioned by pragmatic exigencies and greed appears to be negating the acceptable consultative protocols that garner the requisite psychological contract with the general populace. This research sought to investigate how contextual deficiencies impact on the efficient implementation of mega projects in South Africa. A case in point was the investigation of the pervasive negative public kickback with Megaprojects. The assessment of the equity of the implementational procedures and the investigation of the consultative regimen also assisted in the investigation. Since it is likely that more will be implemented in the future the lessons garnered in these pioneer projects are instructive in the streamlining of implementation processes and pre-empting endemic impediments.

LITERATURE REVIEW

Megaprojects are generally defined as large-scale, complex projects that are designed and constructed over a period of at least four or more years, at a cost of more than USUS$1 billion and involve multiple public and private stakeholders, they are also transformational and impact millions of people (Galloway *et al*., 2013). Megaprojects are found in many fields such as oil and gas extraction, processing projects and even cultural events such as the Olympics. Infrastructural projects have spanned many fields from tunnels, bridges, railways, seaports, mines, freeways and airports (Flyvbjerg, Bruzelius, and Rothengatter, 2003). Because of their substantial direct and indirect impacts to the community, environment and state budgets, Megaprojects attract high level of public attention or political interests.

The Rationale for mega projects

In some countries, Megaprojects are the only way to deliver sustainable development; thus, understanding how they can be used to greater effect is a key to solving major

global problems including poverty alleviation, food security, bolstering of universal health and the improvement of the general welfare of the local citizens (Greiman, 2013). Megaprojects have always been seen as projects which are progressive, instil a feeling of national pride, push technological barriers and most importantly, attempt to solve mega problems with mega solutions (Altshuler and Luberoff, 2003). According to the National Development Plan 2030 in South Africa, over the next twenty years an unprecedented level of investment is predicted in energy infrastructure in South Africa (South Africa, 2014).

Mega projects in Africa

The total demand for infrastructure investment and maintenance from developing countries is estimated at more than US$900 billion a year, with the greatest needs in Africa and Asia. In 2013 Africa grew by about 4% on average, compare to 3% for the global economy, although with broad variations across regions and income groupings. Growth in sub-Saharan Africa was 5% in 2013 and was projected to be about 5.8% in 2014 resulting in many countries increasing infrastructure investment, which should help to improve conditions for manufacturing, boosting export of critical resources and for private sector activity in general (Africa Progress Report, 2015).

Okpamen (2013) highlights that the influx of greater foreign direct investment in Africa, coupled with the rising demand of state-of-the-art infrastructures has ushered in a new dawn of enormous organisations, gradually changing the landscape across Africa. In 2012, several billion dollar projects including the US$6 billion Eko Atlantic mega city in Lagos Nigeria, Tanzania's Oyster Bay, and South Africa's Square Kilometre Array project were initiated. 2013 continued in the same vein, with landmark projects, which rival their global counterparts and there are more in the pipeline in the coming years, as the Africa's economic resurgence continues. The increase in Megaprojects implementation has not been matched by an increase in research in this sector to elucidate their peculiar climatic implementational impediments.

There is a lot of activity in the Megaprojects sector in South Africa executed by the private sector and State Owned Companies (SOC's). Presently in South Africa apart from Eskom the utility company which is building the two largest power plants in the world (Eskom, 2015), Transnet the South African rail, port and pipeline company has embarked on the railway capital expansion project worth US$29.17 billion (Transnet, 2015). In the last five years there was a lot of construction related to the world cup stadia and related infrastructure, the Gauteng Freeway Improvement Project (GFIP) and the Gautrain, a rapid railway system linking the OR Tambo International Airport, Pretoria and Johannesburg. According to the Energy Minister Tina Joemart-Pettersson, the prospect of construction of mega projects looks more positive with the planned construction of Nuclear Power Plants estimated at a cost of between US$33.33 billion and of US$83.87 (Okpamen, 2013).

The impact of mega projects

The majority of Megaprojects that are executed are always associated with a need for them at a particular time, with the exception of white elephants. (Scott, 1992) posits that 'white elephant' projects are not only large and expensive to build; but they operate only for a much hyped prestige, so dominant that the project never fully performs their intended role unclear as that might have been. Most of them fail because there was no adequate design, and that makes them expensive to maintain and the situation is often exacerbated by a lack of a legitimate business case for their

initiation. According to IRN (2003) some projects are the cause of impoverishment for a number of people. Flyvbjerg *et al*., (2003) evaluation of Megaprojects is less positive, not because of their financial and environmental costs but because of their predominant tendency to affect the most vulnerable people. Ribeiro (1987) points out that even though Megaprojects create an outstanding offer of labour, the people coming from local communities, closer to the sites of the project are assigned in the lowest positions of the labour market. The numbers of jobs created represent a small proportion of the massive financial investment for the project.

RESEARCH METHOD

According to Maxwell (2012) to design a qualitative study, involves interconnection and interaction among different design components (Maxwell, 2012). Most pertinently the design must fit not only its use but also its environment. The methods deployed below were the ones we felt would be the most appropriate for this type of research. Interviews were conducted with OUTA and COSATU, key stakeholders who were at the forefront of opposing the GFIP e-tolling. This research is interested in the depth of the data and in appreciating its breath (Wimmer and Dominick, 1997). It was therefore decided that interviewing the people who have studied the project and have challenged the legitimacy of its consultative processes in the courts, through mass demonstration and in the media could yield much in appreciating why there is so much public resistance to this project. NGOs involved with the communities around Medupi power station were also engaged with. The implementing government departments' officials as well as the Eskom officials were interviewed. Interviews were deployed using open-ended questions to gain in-depth information on the issue (Frey and Oishi, 1995). Open-ended questions allow the interviewer, if they wish, to probe deeper into the initial response of the respondent to gain a more detailed answer to the question (Wimmer and Dominick, 1997). The richness of the data can thus be enhanced by this approach.

A questionnaire was used and 1821 respondents cooperated in three shopping malls in Gauteng. The malls were chosen strategically depending on their catchment area and motorists were approached as they alighted their vehicles by trained student research assistants from the University of the Witwatersrand. About 85% of the respondents were from the middle class and the rest were using public transport (trains, buses, minibus taxis), which in South Africa is mostly for people in the lowest rung of social stratification. Ordinary members of the community and general workers involved in the Medupi project were also issued with questionnaires. A questionnaire is defined as a formalized set of questions for obtaining information from respondents. The overriding objective is to translate the researcher's information needs into a set of specific questions that respondents are willing and able to answer. A questionnaire is the main means of collecting quantitative primary data (Malhotra, 2011). A questionnaire enables quantitative data to be collected in a standardized way so that the data are internally consistent and coherent for analysis. This is so that when the questions are asked or presented, it is always in exactly the same way (Brace, 2013). The questions dealt with the citizens' early awareness of the projects and their attitude towards the implementation thereof.

The approach in this study is similar to the one taken by Leromanachou *et al*., (2006) with regards to the Norway's urban tolling where reports, articles, grey literature and a series of semi-structured interviews with the members of the Norwegian Public Road Administration and local authorities were had. The mixed method approach

advocated for earlier on was opted for because it was thought both methods together enhance the perspectival clarity of the research problem intensely than either type by itself (Creswell, 2008). The multiple viewpoints accorded by this approach pits the subjectiveness (which provides depth) of qualitative data against the objectiveness (which provides girth) of quantitative approach. This is complementarily beneficial in assisting researchers in properly appreciating the nature and extent of the phenomenon under scrutiny. Interviews elicited common themes from the respondents and the thematic analysis was used to code these themes, after which they were grouped in order to glean any commonalities that might be meaningful. There are two stages to treating themes, the semantic and the latent level. The semantic looks at the surface meaning of what the data says and does not go beyond what the respondent has actually uttered (Patton, 1990). The overall research design is Convergent Parallel Design where quantitative and qualitative data collection and analysis is done separately but the results of both the questionnaires and interviews are compared and related to offer a substantive interpretation. Not only does this approach offer corroboration from different methods but it proffers a more complete understanding from the two databases.

RESEARCH RESULTS

The Gauteng Freeway Improvement Project (GFIP)

This project involves the upgrading of Gauteng roads, the overhauling of 34 interchanges and the introduction of 4 new directional ramps (fly-overs). This project has 1 million users per day with an anticipated growth in usage. The other improvements on the roads are the Travel Demand Management (TDM) through the introduction of High Occupancy Vehicle lanes. The implementation of Intelligent Transport Systems (ITS) for the effective management of the network. ITS devices such as CCTV will assist in early detection of incident/crashes and assistance/clearance thereof. The provision of lighting which is required for ITS which will improve roadside security. This project has been met with stiff public protestations, low compliance in terms of paying the etoll, rolling juristic disputations and periodic concessions by the government, which do not seem to attract any interest from the general populace. This situation is turning this project into an economic 'white elephant' to the government while its free usage by the public continues unabated.

Medupi Power Station Project

The construction of Medupi power station was started in 2007 to meet Eskom's declining capacity, which had started showing sing of weakness in meeting demand. Medupi is a Greenfield coal-fired power plant project located West of Lephalale, in Limpopo Province. When complete the power station will be the fourth largest coal plant in the Southern hemisphere, and will be the biggest dry-cooled power station in the world. The boiler and turbine contracts for Medupi are the largest contracts that Eskom has ever signed in its 90-year history. The planned operational life of the station is 50 years. The site was chosen because of land availability in close proximity to the primary coal source, the properties of coal from this region are suitable for efficient power generation and also the competitive coal prices in the area. The total output on completion will be 4800 MW and the baseload station will use direct dry-cooling due to the water scarcity in the area. The power station will directly grow the South Africa GDP by approximately 0.35% per year. This project was scheduled to be completed in four years from the commissioning of construction in 2007 but

technical and other problems means only 1of the 6 turbines has been commissioned thus necessitating the new completion date to be moved to 2019.

GFIP results

The majority of the government officials were very defensive about the viability of the project although it is widely reported in South Africa that the compliance is sitting at around 40% at the moment. The leading proponents against the project were emphatic on the viability of other alternatives of revenue collection to support the development, like increasing the fuel and levy and were unhappy about the superficiality of the consultation process. Although the government has won most of the cases in the courts as the challenge to the legitimacy of the implementation of the project without a proper public consultation was rejected by the courts, as the South African National Roads Agency (SANRAL) is legally mandated to initiate and implement road infrastructure projects. SANRAL public legitimacy on the other hand has however been eroded as demonstrated by the low compliance rates. The leading NGOs who are opposed to this scheme are even proposing a complete scrapping of the project. The complaints from the general populace are in table 1.

Table 1: The complaints by the general populace against GFIP

Complaints	Description
Double Taxation	Paying the fuel levy, toll gates and other such taxes in addition to e-tolling
Lack of meaningful consultation	People feel e-tolling was imposed on them and not enough was done to consult them, which depicts a lack of transparency
Affordability	People feel e-tolling is too expensive and unaffordable because of issues such as unemployment, poor pay and generally high costs of living
Lack of awareness of paying	People generally do not understand why they have to pay and don't see what the money is being used for.
Legitimacy	This covers the general public disquiet, which covers issues of government distrust because of widespread corruption and suspected collusion.

Medupi results

The Medupi project was implemented hastily and not enough preparation was done to prepare for the organisational capacity and improve the technical know-how within the organisation. This was the first dry-cooled, baseload station built in 20 years by Eskom after Kendal, Majuba and Matimba power stations. The failing capacity to cope with demand and the concomitant political fallout put pressure to fast-track this project and the implementation is showing structural weaknesses. The problems identified during interviews and elicited from the questionnaires are shown in table 2.

DISCUSSION

The implementation of the aforementioned projects in South Africa was a much anticipated national responsibility by the authorities. The surprise to distant observers is the lack of popular embrace but mass disgruntlement, which is indicative of a soft implementational underbelly. In a new democracy such as South Africa any bad

decision by the authorities becomes over-politicised to a point where the derailment of project becomes a possibility. The GFIP with all its benefits was accepted but it was not supported. This is apparent due to low compliance levels in registering vehicles with the authorities for electronic tolling. This negatively affected the projects cash flow. The same could be said about Medupi where the rush to implement the project meant that labour unions were not properly consulted and this has led to all sorts of protestations ranging from complaints about poor working conditions to resisting hiring skilled foreign workers. This appears to confirm the conclusion made by Wolmar (2013) that Mega projects struggle with public acceptance and support. In these case it is not about the necessity of the projects but the exclusivity of the implementation strategies.

Table 2: The problems encountered in implementing Medupi

Problems	Description
Ambitious Implementation Timelines	Timelines which overlooked capacity issues and labour market volatility in South Africa.
Improper EIA	Failure to conduct a proper Environmental Impact Assessment resulted in the stalling of progress due to the mishandling of culturally sensitive issues, like the relocation of old graves.
Spiralling Costs and Delays	The spiralling costs and delays have led to a political pressure leading to a high executive staff turnover, thus losing momentum on some of the initiatives where gains had been made.
Contractual Expenses	Contractual expenses where coal contracts have to be honoured as the suppliers were ready whereas plant was behind schedule.
Workplace Tensions	Workplace tensions occasioned by the importation of semi-skilled labourers (i.e. welders) amidst local sentiments that locals could have quickly been capacitated.
Costly Technical Mistakes	Costly technical mistakes caused by the inexperience of local experts were magnified by the sheer size of the project.

The power relations always favour the funders of the projects, as government overlook idealistic communicative and deliberative approaches which underpin basic democratic principles (Flyvbjerg, 2003). The superficial consultation process in both cases has led to a situation where in the case of GFIP there was no dialogue in sensitising the public about various alternatives in funding the infrastructure, and the input of stakeholders was not proactively sought as the implementation of the project blindsided most Gautengers. In Medupi a culturally sensitive issue of the relocation of the remains of the ancestors led to a very grave discontentment. The unique observation in South Africa is that all the requirements for implementation are followed, but only furtively to almost maliciously comply with the legislative requirement. That is why the state won all the cases with the GFIP because the implementers exploited the legislative weaknesses with regards to the prescriptive vagueness on the proper consultative protocol with the public.

The top down approach in both instances has been decisionistic much to the negation of the established and functioning institutions accountability (Babatunde *et al*., 2014). In the case of GFIP toll fees were introduced and whenever there is a backlash a discount is introduced without explaining and taking the public into confidence about the basis of such figures. Failure to engage the labour unions and the industry at large

with regards Medupi meant that local labourers and experts were not prepared to tackle a project of this magnitude. Hiring foreign workers in a country of high unemployment such as South Africa was bound to be met with a very stiff resistance. What is unique in the South African situation is that the biggest labour union which is COSATU (Confederation of South African Trade Unions) is actually part of the tri-partite alliance forming the current government. Although it is generally considered to be powerful, in the case of Medupi it actually never mitigated the implementation of unilateral decisions.

The pervasive democratic deficit bedevilling the implementation of mega projects, which is manifested by the inequality in decision-making as posited by Oliomogbe and Smith (2012), has a unique nuance in South Africa. The intensity of the popular resistance has led to the stalling and delaying the completion of the projects, as the critical cooperation from the public is not forthcoming. In the case of GFIP the project is struggling to raise the requisite revenue because of the low compliance levels. In Medupi the implementers had to navigate very complex implementational challenges which although some were technical others, were a direct result of popular disquiet.

CONCLUSIONS

South Africa provides very good prospects for Megaprojects implementation because of the infrastructure backlog. The unique political challenges in South Africa have to be taken on board during the planning and implementation of Megaprojects. The South African general populace is uniquely politically sensitive given the recent political history of repression, so a thorough public consultation strategy and implementation is imperative. These major considerations result in:

- Costly delays due to constant industrial actions which have to be accommodated in the planning of Megaprojects
- Political pressure in implementing some of the projects result in project management difficulties because of little time given to proper planning
- Decisionistic top down approach is met with immediate negative public kickback which could perhaps be avoided with proper inclusive decision-making
- Megaprojects perceived democratic deficit cannot survive as a parallel system in an otherwise democratic dispensation, as the incongruence which could be occasioned by asymmetric power relations leads to public disquiet
- The problems encountered are suggestive of institutional weaknesses and legislative vagueness which need correction

However the lessons garnered in the few Megaprojects that have been implemented in South Africa are very instructive even to other developing countries especially those which are currently transformational.

REFERENCES

Africa Progress Panel (2015) *Power, People, Planet: Africa Progress Report 2015*. Geneva: Africa Progress Panel.

Altshuler, A, and Luberoff, D (2003) *Mega-Projects: The Changing Politics of Urban Public Investment.* Washington DC/Cambridge: Brookings Institute Press.

Babatunde, S, Perera, S, Udeaja, C and Zhou, L (2014) Challenges of implementing infrastructure megaprojects through public-private partnerships in Nigeria: A case of study of road infrastructure. *International Journal of Architecture, Engineering and Construction*, **3**(2), 142-154.

Brace, I (2013) *Questionnaire Design: How to Plan, Structure and Write Survey Material for Effective Market Research*. London: Kogan Page Publishers.

Delloite (2015,) *Andre Pottas*. Delloite. Available from http://www2.deloitte.com/za/en/profiles/apottas.html [April 4th 2016].

Edwards, J F (2003) Building the great pyramid: Probable construction methods employed at Giza. *Technology and Culture*, **44**(2), 340-354.

Eskom (2015) *Medupi Power Station Project*. Johannesburg: Eskom.

Flyvbjerg, B (2003) *Megaprojects and Risk*. London: Cambridge.

Flyvbjerg, B, Bruzelius, N and Rothengatter, W (2003) *Megaprojects and Risk: An anatomy of Ambition*. Cambridge: Cambridge University Press.

Frey, J and Oishi, S (1995) *How to Conduct Interviews by Telephone and in Person*. London: Sage Publications.

Galloway, P, Kris, P, Nielsen, R and Dignum, J (2013) *Managing Giga Projects; Advice from Those Who've Been There, Done That*. Reston, Virginia: ASCE Press.

Gauteng Government (2016, April 3) *Economy of Gauteng*. Available from http://www.gautengonline.gov.za/Business/Pages/TheEconomyofGauteng.aspx [April 6th 2016].

Greiman, V (2013) *Megaproject Management: Lessons on Risk and Project Management from the Big Dig*. Hoboken, NJ: John Wiley and Sons, Inc.

International Rivers Network (2003) *Twelve Reasons to Exclude Large Hydro from Renewable Initiatives*. International Rivers Network.

Kennedy, L, Robbins, G, Bon, B, Takano, G, Varrel, A and Andrade, J (2014) *Megaprojects and Urban Development in Cities of the South*. Bonn: Chance 2 Sustain, Work Package 2 Thematic Report.

Leromanachou, P, Potter, S and Warren, J (2006) Norway's urban toll rings: Evolving towards congestion charging? *Transport Policy*, **13**(5), 367-378.

Malhotra, N K (2011) Questionnaire Design and Scale Development. Georgia Institute of Technology. Available from http://www.terry.uga.edu/~rgrover/chapter_5.pdf [Accessed January 30th 2014].

Maxwell, J (2012) *Qualitative Research Design*. New York: Sage Publications.

Mushni, R (2014, December 11) *Can South Africa Still Pull Off Mega-Projects*. Rand Daily Mail. Available from: http://www.rdm.co.za/business/2014/12/11/can-south-africa-still-pull-off-mega-projects [Accessed April 4th 2016].

Okpamen, E (2013) *Top 5 Infrastructural Projects in Africa 2013*. Ventures Africa. Available from http://venturesafrica.com/top-5-infrastructural-projects-in-africa-2013/ [Accessed April 6th 2016].

Oliomogbe, G and Smith, J N (2012) *Value in Megaprojects*. Leeds: University of Leeds.

Ribeiro, G (1987) Cuanto más grande mejor? Proyectos de gran escala: una forma de producción vinculada a la expansión de sistemas económicos. *Desarrollo Económico*, 27(105), 3.

Scott, P (1992) *A Herd of white Elephants: Some Big Technology Projects in Australia*. Sydney: Australia Hale and Iremonger.

South Africa (1996) *The Constitution of the Republic of South Africa, 1996*. Pretoria: Government Gazette.

South Africa (2014) *National Development Plan 2030*. Pretoria: South African Government.

Transnet (2015) *Capital Planning*. Johannesburg: Transnet.

Wimmer, R and Dominick, J (1997) *Mass Media Research: An Introduction*. Belmont, MA: Wadsworth.

Wolmar, C (2013) *Judging the success of megaprojects*. London: Meeting of the Minds.

EVOLUTIONARY COLLABORATION NETWORK AND ORGANIZATIONAL COMPETITIVENESS IN MEGAPROJECTS

Yujie Lu[1], Da Pang[2] and Yongkui Li[3]

[1] *Department Of Building, School of Design and Environment, National University of Singapore, 4 Architecture Drive, 117566, Singapore*

[2&3] *Department of Construction Management of Real Estate, School of Economics and Management, Tongji Building A, Tongji University, Siping Road 1500, Shanghai 200092, China*

The collaboration network is a compilation of relationships among multiple stakeholders within and across organizations. In a megaproject that involves with hundreds of organizations, these organizations may dynamically collaborate for a sub-project while compete for a new sub-project. However, who are the organizations that have competitive advantages to win more tenders and the reason of how these companies are emerged haven't been fully investigated yet. Thus, to study the network-based organizational competitiveness in a megaproject is critical for its execution and future success. This study analyses the organizational competitiveness and evolution of collaboration network by social network analysis (SNA) and a 6-years (2008-2013) case study of district development in Wuxi, China with a total of 1,897 construction projects. The constructed megaproject collaboration network consists of four parties: owners, contractors, designers and quality supervisors. The analytical result shows several key observations and trends of stakeholders in the evolution of the network. Contractors and designers who have a higher normalized degree and are in K-core are more competitive when bidding for a new project. This study enriches the existing research for the organizational competitiveness in megaprojects, helping us to better understand the mechanism of collaboration and competition in megaprojects and to offer effective and dynamic governing strategies for megaprojects.

Keywords: megaprojects; collaboration network; network evolution; governance strategies

INTRODUCTION

Large-scale city infrastructure construction has become a critical supporting pillar for social development. As the scale of a project increases from single project to city-level or regional level megaprojects, the project requires higher investment (Flyvbjerg, 2014), greater amount of stakeholders (Lu, Li, Pang, and Zhang, 2015), and higher complexity than the project ever before. Given the complexity in a megaproject, the close collaboration among different stakeholders is a must to fulfil the megaprojects task instead of relying on the capacity of single stakeholder. A compilation of these collaborations among multiple stakeholders within and across organizations in a megaproject constitutes a collaboration network. Meanwhile, during the process of implementation and dynamic evolution, contractors also need to compete for new

[1] luy@nus.edu.sg

Lu, Y, Pang, D and Li, Y (2016) Evolutionary Collaboration Network and Organizational Competitiveness in Megaprojects. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 813-822.

project opportunities. Thus, study on evolution of megaproject collaboration network and organizational competitiveness will help to improve performance and management of megaprojects. Current studies mainly use a static perspective to analyse a single megaproject, but ignore the dynamic collaboration and its influence to a megaproject. Understanding such a collaboration network can indeed help better identify the organizational competitiveness.

This study aims to investigate the organizational competitiveness (herein refers to bidding competitiveness) in a collaboration network. Specifically, four objectives will be explored, including 1) to analyse the collaboration network, its dynamic evolution, and organizational competitiveness in a megaproject; 2) to investigate the tender selection strategies by owners; and 3) to identify effective governance strategies for different types of megaprojects. The results can enrich current megaprojects study by providing better understanding of dynamic evolution and organizational competitiveness of organizations and by providing practical strategies for governing megaprojects.

The paper is structured in six sections. The next section reviews pertinent studies, followed by section three that explains the research design. Section four explains data processing and operationalization of hypothesis. The results of the organizational competitiveness and owners' tender strategies are discussed in section five. The last section summarizes this study.

LITERATURE REVIEW

Megaprojects

The definition of "megaprojects" has a long term debate without a universal agreement. A megaproject could be defined and characterized in different aspects, such as by its investment expenditures which is higher than $1 billion USD (Bruzelius, Flyvbjerg, and Rothengatter, 2002), by its duration longer than one political dispensation (O Oliomogbe and J Smith, 2013), by its scale that involve colossal in size and scope (Sturup, 2009), or by its complexity with multiple owners (Haynes, 2002) and organizations that seek success with different objectives (Ruuska, Artto, Aaltonen, and Lehtonen, 2009).

Considering megaprojects' characteristics and its complexity, megaprojects management (MPM) faces tremendous challenges (Zhai, Xin, and Cheng, 2009). Currently, most of current research on megaprojects management focus primarily on several aspects, such as stakeholders' value (Zhai et al., 2009), performance (Kwak and Smith, 2009), risk management (Locatelli and Mancini, 2010) and governance (Müller, Pemsel, and Shao, 2014).

In sum, most of existing studies investigate the management of megaproject by providing a static snapshot analysis, however, the literature hasn't studied the dynamic evolution of megaproject during its different phases. Given that the megaproject is highly complex and evolves along the time, there is a research need to investigate the dynamic evolution of megaprojects.

Network analysis

Research on "network" has grown extensively in past decades, such as organizational network, collaboration network and social network and so on. In a construction project, all organizations are social networks and can be addressed in terms of a set of nodes linked by social relationships (Liu, Han, and Xu, 2015). Studying the network

can allow scholars better understand the position, power and trajectory of an organization. For instance, Chowdhury, Chen, and Tiong (2011) applied network theory to identify and to distinguish potential stakeholders in Public Private Partnership (PPP) affiliation. Recently, collaboration network analysis has been widely adapted in the construction field. Park, Han, Rojas, Son, and Jung (2010) produced a collaboration network model to investigate a variety of collaboration patterns and their impacts on the level of profit performance. Liu (2015) investigated evolutionary analysis of the collaboration networks within National Quality Award Projects of China by using SNA.

However, several limitations exist in the existing studies of social network and collaboration network in the construction field. First, most of the construction project network were identified through objective judgement, such as questionnaires and interviews from stakeholders, but haven't used subjective measurement based on real data collected from projects. Second, most of the studies focused on the static network in a particular year, but ignored the dynamic evolution of the collaboration network that is constantly expanded by additional stakeholders and their relationships. These two research gaps will be fulfilled in this study.

Social capital and competitiveness

In a network, it's not what you know but who you know, which sums up much of the conventional wisdom regarding social capital. The term social capital was originally used to describe the relational resources embedded in cross-cutting personal ties, which are useful for the development of individual in community social organizations (Jacobs, 1961; Loury, 1977). As the concept evolved, Coleman (1988) and Burt (2000) stated that social capital represents the ability of actors to secure benefits by virtue of membership in social networks or other social structures. At individual level, social capital is a kind of capital that can create for certain individuals a competitive advantage in pursuing their ends (Burt, 2000). Better connected actors are more competitive and gain higher returns. The competitiveness of a construction organization can be interpreted in different ways, such as the ability to obtain more resources, to win more tenders, to keep good relationship with clients, and so on. For designers and contractors, the key competitiveness can be measured by their capacity of wining new projects, also interpreted as the competitiveness in bidding in this study. During dynamic evolution of megaprojects, the analysis of network-based organizational competitiveness can facilitate the implementation of megaprojects and improve its management efficiency.

In summary, although megaprojects have been studied form different perspectives, most of current studies focused on the static analysis of a single project but ignored dynamic evolution. Thus, based on SNA and case study, this study aims to analyse the dynamic evolution and organizational competitiveness of megaprojects to provide a new perspective for the megaprojects management.

RESEARCH DESIGN

To fulfil above aim, two hypotheses were firstly proposed to analyse the network evolution and organizational competitiveness. Then, SNA conceptual model was constructed and measured by standardized degree centrality and K-core. Thirdly, two hypotheses were operationalized in the context of collaboration network and its characteristics. Hypothesis 1 and hypothesis 2 are designed to measure the social

capital based on the network position. The research framework is established as follow (see Figure 1).

Hypotheses

According to the social network theory, the node with higher degree centrality normally stands in a core position of the network and possess greater power and influence (Scott and Carrington, 2011). This advantage can represent more resources, more investment opportunities (Hochberg, Ljungqvist, and Lu, 2007) and higher social prestige (Scott and Carrington, 2011).

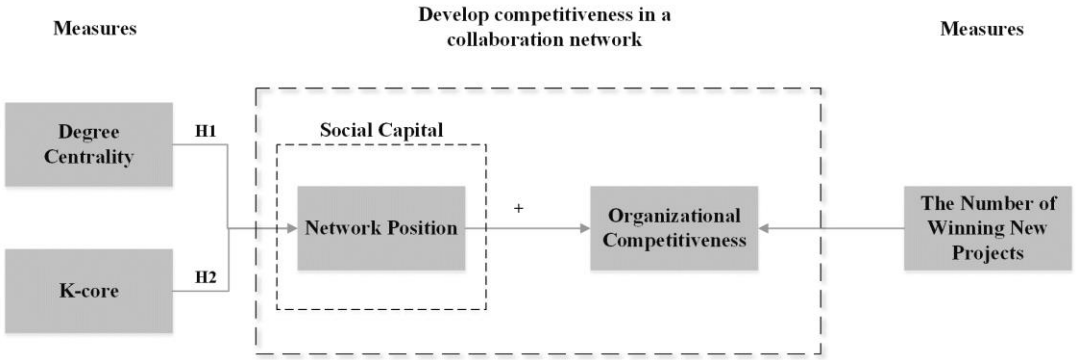


Figure 1 Research Framework and Hypotheses

In megaproject construction that includes thousands of sub-projects, this advantage can be interpreted as the capacity of winning more projects in the competitive tender. Thus, this study proposes the first hypothesis (H1):

H1: the higher degree centrality the organizations have, the more competitive they are to win more projects.

Competition and collaboration commonly coexist among organizations with equal importance. Emphasis on competitiveness should not neglect the synergy of inter-enterprise collaboration in a network (Echols and Tsai, 2005). In social network theory, K-core is commonly used to measure the cohesive subgroups in a network. The higher K-core means the nodes in this K-core have closer collaborative relationship and are more cohesive. In megaproject, various participants need to collaborate with one another to achieve project goals. Those who have closer collaboration are more likely to possess and to share more project opportunities in a network. Thus, this study proposes the second hypothesis (H2):

H2: the higher K-core the organizations are from, the more competitive they are to win more projects.

Operationalization of hypothesis

H1 and H2 are related but different concepts. H1 measure the relation of a single organization in a network while the H2 measures the relation of a subgroup and its included organizations. Specifically, H1 is used to investigate the organizational competitiveness and their network position for various contractors and designers in the collaboration network. Based on normalized degree centrality, top 30 designers and contractors were respectively selected to analyse the relation between their degree centrality ranks (in the current year) and the number of projects that designers and contractors participated (in the following year).

For H2, the study will investigate the relation between K-core (in the current year) and the average number of projects that designers and contractors participated in

respective K-core (in the following year). In each year, the highest K-core, the second highest K-core, the third highest K-core, and the rest of K-core were identified from the collaboration network. The average number of a project involved with designers and contractors from each of above identified K-core was calculated and compared among one another. For instance, if the highest K-core is 4-core, the second highest K-core is 3-core. Then the average number of project participated by the organizations in 4-core was compared to that of the organizations in 3-core.

Measures

For H1, degree centrality represents the number of links that a node has in the network (Quinn, Chen, and Mulvenna, 2012), which is a critical measure to evaluate the power, influence and social prestige of a node in a social network (Scott and Carrington 2011). The study adopts the normalized degree centrality (Ndegree) proposed by Freeman (1979) to standardized the results for comparison. The formula is shown below:

$$C_{Ndi} = \frac{\sum_i p_{ij}}{n-1}$$

Where, p_{ij} *represents the number of links between node* i *and node* j *;* $\sum_i p_{ij}$ *represents the degree centrality of node* i*; and* n *represents the total number of nodes in a network.*

For H2, K-core is used to measure the degree of collaboration among organizations in the network. K-core is a cohesive subgroup on the basis of degree which represents each node in this subgroup has at least K direct links with other nodes in this subgroup (Seidman, 1983). For instance, 0-core represents the network itself, and 3-core represents the subgroup that the degree centrality of each node is at least 3. The higher the K-core is, the more cohesive this subgroup is. That is to say, the organizations in a 5-core subgroup have closer collaboration relationship among one another than those in a 3-core. It's worth mentioning that in a K-core subgroup (say, a 3-core), an organization may have 3 or more links. In this study, only organizations with exactly 3 links were selected for the analysis.

Case Selection and data processing

This study selected a typical case of large-scale land development zone in Wuxi, China. Wuxi is a city located in the southern part of Jiangsu province, China, with a population of 6.4 million. Wuxi national hi-tech development zone (WNHTDZ) was founded in 1992, and listed as one of the nation's high and new technology zones. From 2008 to 2013, a total of 1,897 new construction projects were approved in WNHTDZ, including 946 civil engineering projects (50%), 189 municipal engineering projects (10%) and 762 industrial projects (40%). In this study, we regarded this 6-years long-term construction development of 1,897 projects as a megaproject. To complete these projects, more than 1000 relevant companies were involved in the construction activities. These companies and their relations form a complex collaboration network.

One of the authors worked closely with WNHTDZ and collected second-hand data since 2008. The data were extracted from the information system hosted by WNHTDZ administration. A total of 1,897 new construction projects that happened from 2008 to 2013 were selected as data input in SNA model. There are 1450

contractors, including 680 owners (investors), 174 designers, 541 contractors, and 55 supervision units.

The study will consider six-years (2008-2013) of collaboration network evolution. In each year, the collaboration network was computed based on the "2-year" rule, meaning that average construction duration in WNHTDZ will last for 2 years. To align with this norm, the network in each year constituted all relevant participants in that particular year and also in the previous year. For instance, when calculating the network for 2012, all companies involved in 2012 and in 2011 were considered in the network. This 2-year rule ensures the continuity and coherence of the SNA model with the construction practice.

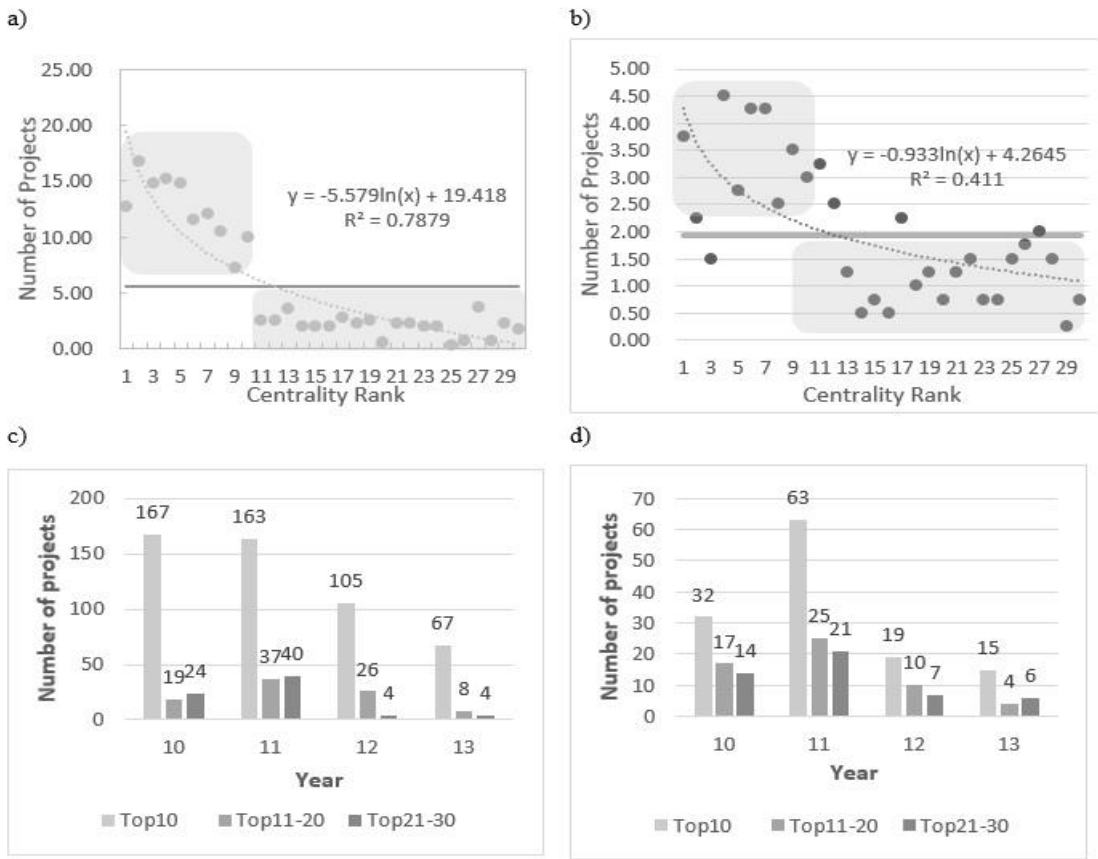


Figure 2 the Relationship between centrality rank and the number of projects that designers and contractors participated.

Fig. 2a) Relationship between centrality rank (in current year) and the number of projects that designers participated (in the following year); Fig. 2b) Relationship between centrality rank (in current year) and the number of projects that designers participated (in the following year); Fig. 2c) The number of projects that designers with different centrality participated in the years; Fig. 2d) The number of projects that contractors with different centrality participated in the years.

**Note: the nodes marked in darker grey in Figure 2a and 2b represent the average new projects in which those who rank the same place in each year network participate next year.*

RESULT AND DISCUSSION

Organizational competitiveness based on degree centrality

PIPs network will be mainly discussed in this part. During the evolution of megaprojects, with the centrality rank declining, the average number of new projects that designers and contractors participate in next year show a gradual descending trend (see Figure 2a and 2b). And the designer has higher R2 than that of contractor through fitting analysis (0.78 > 0.41). That means the trend for designers is more obvious. Furthermore, in terms of degree centrality, the top 10 designers and contractors are more competitive when facing a new project because of the dominant network position.

Figure 2c and 2d respectively show the number of new projects that top ranked designers and contractors participate in next year. During the evolution of megaprojects, whether designers or contractors, the total number of new projects that top 10 organizations participate in are larger than that of latter 20 organizations. And in each year network, the organizations with higher degree centrality are more competitive when facing a new project and can win more project. Compared to contractors, designers show a more obvious advantage. For designers and contractors, the relationship between degree centrality and the number of new projects that they participate in next year is non-linear.

Base on above analysis, during the evolution of megaproject, the organizations with higher degree centrality are more competitive to win more projects. However, compared to contractors, designers show a more obvious advantage. Thus, H1 could be validated.

Organizational competitiveness based on K-core

Figure 3a and 3b show the average number of new projects that designers and contractors in respective K-core participate in next year.

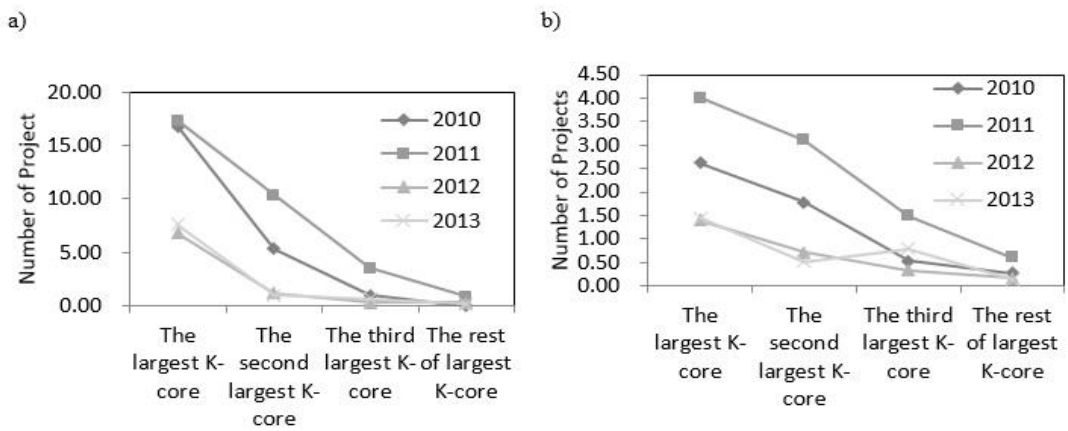


Figure 3 the number of projects that designers and contractors in different K-core participated in different years. a) the number of projects that designers in different K-core participated in different years; b) the number of projects that contractors in different K-core participated in different years.

For both designers and contractors in respective K-core, with the K-core dropping, the average number of new projects that they participate in next year show a non-linear decreasing trend. The larger the K-core is, the more competitive the organizations in that K-core are when facing a new project. Furthermore, when the K-core increases

by 1, the organizations in this K-core have multiple opportunities to win a new project, especially for designers.

On the one hand, above finds explain why the organizations make effect to occupy the core position in the network, which means strong competitiveness and can enable these organizations to win more new projects; on the other hand, the larger K-core represents closer collaboration relationship between organizations. Compared to those in lower K-core, the organizations in larger K-core can take advantage of their network position and share more chances to win or participate in more new projects, especially for designers.

Base on above analysis, during the evolution of megaproject, the organizations in larger K-core are more competitive to win more projects. However, compared to contractors, designers show a more obvious advantage. Thus, H2 could be validated.

CONCLUSION

This study investigated organizational competitiveness in a megaproject collaboration network based on SNA and case study. A new framework with two hypotheses was proposed and tested in the PIPs collaboration network. The key conclusions are summarized as follows. Firstly, the organizations with higher degree centrality have larger social capital and are more competitive to win new projects. This finding is more significant for designers than contractors. In the result, top 10 designers had absolute advantages to win new projects than the ones ranked lower. Contractors showed the similar result, yet with large fluctuations. Secondly, the organizations in higher K-core also have closer collaboration and more social capital. Compared to those in lower K-core, the organizations in higher K-core can leverage their network position and secure more chances to win new projects. Similarly, this finding is especially true for designers rather than contractors.

The finding of this study can also provide insightful implications to megaproject governance and administration in several aspects, such as to monitor the longitudinal changes of network position and structure, to identify key organizations and their performance in the collaboration network, and to make differentiated and targeted policies based on organizations' power. In particular, first, the governance of PIPs network needs focus on the design consortium, which show preliminary sign of monopoly of wining new projects. Second, the government may also design precaution policies that prevent the negative behaviours, such as corruption and collusion, due to high degree centrality in the design market. Third, designers and contractors are able to strengthen their social capital and to improve the competitiveness in two ways. One is to improve the satisfactory relationship with existing owners, in expectation of obtaining future project opportunities; another is to increase their network power by extending their relations and reaching out to key stakeholders in the collaboration network.

This study contributes to the existing knowledge in two ways: 1) is to introduce the network analysis (such as positions and collaborative relationship) as an additional dimension to the organizational competitiveness; and 2) to enrich the research on the megaproject management from the dynamic evolutionary perspective and from stakeholders' collaborations. Although this study selected a typical case in Wuxi, the discussion and conclusion from this study could potentially contribute to understanding organizational competitiveness in other construction projects network in other national development zones.

However, several limitations exist in this research. First, the study only analyses organizational competitiveness of PIPs network, but does not investigate organizational competitiveness of GIPs network. The future research can conduct analysis of organizational competitiveness of GIPs network. Second, this study focuses more on the network measures, but hasn't considered the performance of designers and contractors, such as the project quality, cost and schedule. Therefore, further study can establish the linkage between network measure and project performance in order to better understand the organizational competitiveness of megaproject collaboration network.

REFERENCE

Bruzelius, N, Flyvbjerg, B and Rothengatter, W (2002) Big decisions, big risks Improving accountability in mega projects. *Transport Policy*, **9**(2), 143-154.

Burt, R S (2000) The network structure of social capital. *Research in Organizational Behavior*, **22**, 345-423.

Chowdhury, A N, Chen, P H and Tiong, R L K (2011) Analysing the structure of public–private partnership projects using network theory. *Construction Management and Economics*, **29**(3), 247-260.

Coleman, J S (1988) Social capital in the creation of human capital. *American Journal of Sociology*, **94**(Supplement 95-S120).

Echols, A and Tsai, W (2005) Niche and performance: The moderating role of network embeddedness. *Strategic Management Journal*, **26**(3), 219-238.

Flyvbjerg, B (2014) What you should know about megaprojects and why: an overview. *Project Management Journal*, **45**(2), 6-19.

Freeman, L C (1979) Centrality in social networks conceptual clarification. *Social Networks*, **1**(3), 215-239.

Haynes, W (2002) Transportation at the millennium: In search of a megaproject lens. *Review of Policy Research*, **19**(2), 62-64.

Hochberg, Y V, Ljungqvist, A and Lu, Y (2007) Whom you know matters: Venture capital networks and investment performance. *The Journal of Finance*, **62**(1), 251-301.

Jacobs, J (1961) *The Death and Life of Great American Cities*. New York: Vintage.

Kwak, Y H and Smith, B M (2009) Managing risks in mega defense acquisition projects: performance, policy, and opportunities. *International Journal of Project Management*, **27**(8), 812-820.

Liu, L, Han, C and Xu, W (2015) Evolutionary analysis of the collaboration networks within National Quality Award Projects of China. *International Journal of Project Management*, **33**(3), 599-609.

Locatelli, G and Mancini, M (2010) Risk management in a mega-project: The Universal EXPO 2015 case. *International Journal of Project Organisation and Management*, **2**(3), 236-253.

Loury, G (1977) A dynamic theory of racial income differences. *Women, minorities, and employment discrimination*, **153**, 86-153.

Lu, Y, Li, Y, Pang, D and Zhang, Y (2015) Organizational network evolution and governance strategies in megaprojects. *Construction Economics and Building*, **15**(3), 19-33.

Müller, R, Pemsel, S and Shao, J (2014) Organizational enablers for governance and governmentality of projects: A literature review. *International Journal of Project Management*, **32**(8), 1309-1320.

O Oliomogbe, G and J Smith, N (2013) Value in megaprojects. *Organization, Technology & Management in Construction: An International Journal*, **4**(Special Issue), 617-624.

Park, H, Han, S H, Rojas, E M, Son, J and Jung, W (2010) Social network analysis of collaborative ventures for overseas construction projects. *Journal of Construction Engineering and Management*, **137**(5), 344-355.

Quinn, D, Chen, L and Mulvenna, M (2012) Social Network Analysis: A Survey. *International Journal of Ambient Computing and Intelligence*, **4**(3), 46-58.

Ruuska, I, Artto, K, Aaltonen, K and Lehtonen, P (2009) Dimensions of distance in a project network: Exploring Olkiluoto 3 nuclear power plant project. *International Journal of Project Management*, **27**(2), 142-153.

Scott, J and Carrington, P J (2011) *The SAGE Handbook of Social Network Analysis*. London: Sage Publications.

Seidman, S B (1983) Network structure and minimum degree. *Social Networks*, **5**(3), 269-287.

Sturup, S (2009) Megaprojects and governability. *International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering*, **3**(6), 862-871.

Zhai, L, Xin, Y and Cheng, C (2009) Understanding the value of project management from a stakeholder's perspective: Case study of mega-project management. *Project Management Journal*, **40**(1), 99-109.

DOES INAPPROPRIATE QUALITY CONTROL DEMOTIVATE WORKERS? A CRITICAL REVIEW

Tara Brooks[1] and John Spillane

School of Architecture, Planning and Civil Engineering, Queen's University, University Road, Belfast, BT7 1NN, Northern Ireland, UK

The construction industry requires quality control and regulation of its contingent, unpredictable environment. However, taking too much control from workers can disempower and demotivate. In the 1970s Deci and Ryan developed self-determination theory which states that in order to be intrinsically motivated, three components are necessary - competence, autonomy and relatedness. This study aims to examine the way in which the three 'nutriments' for intrinsic motivation may be undermined by heavy-handed quality control. A critical literature review analyses construction, psychological and management research regarding the control and motivation of workers, using self-determination theory as a framework. Initial findings show that quality management systems do not always work as designed. Workers perceive that unnecessary, wasteful and tedious counter checking of their work implies that they are not fully trusted by management to work without oversight. Control of workers and pressure for continual improvement may lead to resistance and deception. Controlling mechanisms can break the link between performance and satisfaction, reducing motivation and paradoxically reducing the likelihood of the quality they intend to promote. This study will lead to a greater understanding of control and motivation, facilitating further research into improvements in the application of quality control to maintain employee motivation.

Keywords: human resources management, motivation, quality control

INTRODUCTION

Quality management has become 'reified' and accepted as rational 'best practice,' ignoring the potential downsides and ethical implications of implementation (Hodgson and Cicmil 2007). Observation and measurement creates power asymmetry that renders actions "visible, calculable and above all, manageable" (McKinlay *et al*., 2010, 1015-16). Control can be amplified through 'identity regulation' (Alvesson and Willmott 2002) which manipulates the subject's 'self-construction.' These techniques are ostensibly rational, objective and their definitions and categorisations have been widely accepted and therefore legitimised (Hodgson and Cicmil 2007).

This rationalisation and creation of the 'governable person' started with Taylor's scientific method of management (1947) which suggested that previous ad hoc methods of controlling the industrial workforce were inadequate and that a new, 'scientific' approach should be taken. This system depends on measurement and observation of the performance of every employee, who is rewarded or penalised accordingly. Taylor advocated that "A high priced man has to do exactly as he's told

[1] tbrooks04@qub.ac.uk

Brooks, T and Spillane, J (2016) Does Inappropriate Quality Control Demotivate Workers? A Critical Review. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 823-832.

from morning till night" (Taylor 1947, 45). Wolin (1960, cited Fry 1975) suggested that Taylorism was anti human, subordinating social standards to production schedules. Taylorism failed because it distrusted workers and was based on excessive control (Styhre 2001).

Foucault conceives of autonomy as constrained by systems and society (Wong, 2010); whereas self-determination theory takes an organismic, humanistic approach describing autonomy as being the perceived source of your own actions, although this is influenced by your environment. This study, using self-determination theory as a framework, takes a different perspective than that of Foucauldian studies of regulation and control. Self-determination theory explicitly rejects Skinnerian behaviourism, which finds that man is a product of the stimuli in his external environment, holding that free will exists. The concepts of autonomy, relatedness and competence at an individual level are central to self-determination theory. Taking the extreme example of Taylorism demonstrates how control at work may undermine these psychological 'nutriments' indicating the potential use of self-determination theory as a framework to cast light from a new perspective on control and regulation.

Construction is highly contingent and unpredictable (Clegg *et al*., 2002; Till 2007) hence some degree of regulation is required over the people who try to control this environment, to ensure compliance with laws and regulations (Christ *et al*., 2012). The research question is, when does regulation and control reduce autonomous motivation and hence become counterproductive. This knowledge can then be used to improve the application of quality control in such a way that it nurtures and supports workers' motivation. Foucauldian thinkers (Alvesson and Willmott 2002; Clegg *et al*., 2002; Hodgson 2005; Hodgson and Cicmil 2007; McKinlay *et al*., 2010) examine power and control at a system level in organisations, but do not approach the subject from the perspective of self-determination theory. Self-determination theory and the relationship between control and motivation has been applied to the fields of sport, healthcare, education, parenting, politics and religion (Deci and Ryan 2011) but little research has been undertaken in construction management, a research gap which this study aims to fill.

RESEARCH METHOD

This paper uses self-determination theory as a framework for examination of the control and motivation of workers. This theory has been developed over three decades and proven through empirical validation (Gagne and Deci 2005). 58 papers are selected from peer reviewed sources which best meet the inclusion and exclusion criteria. Inclusion criteria incorporate papers from fields outside construction, including studies of self-determination theory; ISO 9001 quality control; quality control compliance, resistance to management processes, deception; ISO 9001 auditing, feedback, and continual improvement. Exclusion criteria comprise non-peer reviewed work, a number of studies with a high degree of cross pollination and repetition, and ultimately conference paper constraints. The identified literature is coded using NVivo software against the headings of assessment and auditing, feedback, continual improvement, deception, competence, relatedness and autonomy in order to synthesise and explore the relationships outlined below.

The framework: Self-determination theory

Self-determination theory suggests that one can be motivated to undertake an interesting task for its own sake. Motivation involves activation, energy, intensity, persistence, direction (Ryan and Deci 2000). Motivation is "a cognitive

representation of a desired future state" (Deci 1975, 96) and work motivation "…a set of energetic forces that originate both within as well as beyond an individual's being, to initiate work related behaviour, and determine its form, direction, intensity and duration" (Pinder 2008, 11). The self-determination movement takes a cognitive approach that assumes that active thought processes determine behaviour. This theory rejects mechanistic, behaviourist methods where humans are assumed to be predictable, controlled by external forces and will merely process and respond to external stimuli.

Deci (1975) used the work of DeCharms, White, Piaget and Maslow, Vroom's expectancy theory and his own observations to build his model of motivated behaviour. Intrinsic motivation occurs when an individual finds an activity satisfying in itself - when the activity is undertaken with no thought for external reward. It is thought to be innate as studies have shown that very young babies display intrinsic motivation (Deci 1975). The theory of intrinsic motivation starts with the concept that man has a number of basic psychological needs (competence, autonomy and relatedness) which are 'essential nutriments' to optimal psychological functioning (Deci and Ryan 2011, 19) and are universal. Environments which support these needs will enhance self-motivation and enhance well-being, social functioning and optimal development. Whereas not meeting a physiological need will lead to an increasing desire to meet it (for example an increased motivation to find food if hunger is not satisfied), an unsatisfied psychological need will lead to internal self defence mechanisms, withdrawing to protect oneself from the external environment, and potentially to poor mental and physical health (Deci and Ryan 2000).

In 2000, Deci and Ryan further refined their theory, suggesting that self-determination existed along a continuum, ranging from amotivation to intrinsic motivation. This continuum is useful when considering motivation in the context of work: few people are lucky enough to work for the love of the task, however it should be possible to move people further along the continuum towards more intrinsic motivation.

Perceived locus of causality and autonomy

'Authentic' motivation is activated by an individual in the absence of external pressure or control. When acting this way an individual is said to have an internal locus of causality. Studies show that external influences - whether criticism and negative feedback (Deci *et al*., 1973), competition, threats (Deci and Cascio 1972), or even positive influences such as praise and monetary reward - can create a perceived external locus of causality, which undermines intrinsic motivation. It is difficult if not impossible to maintain intrinsic motivation when actions are being dictated by others and the individual feels like a pawn in someone else's plan. This emerging hypothesis was confirmed by a meta-analysis of 128 experimental studies undertaken by Deci Koestner and Ryan in 1999.

Deci suggests that "rewards are generally used to control behaviour" (Deci 1975, 141). His experiments in 1972 show that when tasks started as intrinsically interesting ones but are subverted by external influence, the perceived locus of causality changes and intrinsic motivation decreases. Extrinsic rewards can make the subject feel like they are being manipulated and they feel much less the master of their own destiny (Deci 1975). If people are undertaking a task to receive an extrinsic reward (or to avoid a punishment), they will only continue with that task as long as the reward is offered or punishment threatened. Deci (1975) does find that where rewards or payment are given in a non-controlling manner, not contingent on an individual's

performance, their negative impact on intrinsic motivation is reduced. Extrinsic rewards may be useful for one off or short term performance but longer lasting effects can be produced through intrinsic motivation. These studies lead Deci and Ryan to suggest that an individual must feel that their actions are autonomous and self-determined in order to be intrinsically motivated, and that autonomy supportive environments lead to greater integration of tasks and regulations (Deci and Ryan 2000). This explains why carrot and stick motivation methods work short term, but in the long term may be counterproductive.

Competence

If workers feel that they are being challenged at an optimal level - their workload is neither boring nor beyond their capability - they will experience greater feelings of competence. They will feel that they are controlling their work, not that their work is controlling them (Gagne and Ryan 2005). Work environments with undue external control and regulation have been shown to shift the workers' perceived locus of causality. The workers become less interested in the work itself, but are focused on meeting the targets of the regulatory regime and avoiding subsequent penalties (Ryan and Connell 1989; Gagne and Deci 2005). Their feelings of competence are undermined as their output is picked over for faults. Their perception of autonomy is lowered; they are clearly not trusted to work without observation and control. The workers in this environment are likely to have either extrinsic or introjected motivation. Carrot and stick control measures give short term results but can result in 'gaming the system' - cheating and fraud (Gagne and Deci 2005). Deci (1975, 222) discusses controlling work systems: "if no one is looking, people tend not to do what they are supposed to do…often, in fact, people will satisfy their intrinsic need to be creative and competent by devising ways to beat the system…this may take the form of subtle sabotage and will certainly manifest itself in people trying to get the greatest rewards from the organisation while giving the least effort to the organisation."

Relatedness

Individuals must feel a secure connection with others and feel that they are accepted as a part of a group in order to be psychologically healthy (Deci and Ryan 2000). The need for belonging is met when working in a supportive environment with actions perceived as contributing to the benefit of the group (Riketta and Van Dick 2005). Internalisation of ('buying into') a task is fostered when relatedness is supported (Gagne and Deci 2005).

Quality Control Assessed Through the Framework of Self Determination Theory

The importance of organisational culture on the effectiveness of the implementation of quality control has been well reported (Dick *et al*., 2008; Sampaio *et al*., 2012; Fonseca 2015) however the effect that the application of quality control has on the autonomy, competence and relatedness of those implementing it has been overlooked. Quality control systems typically involve assessment and auditing; feedback; and a commitment to 'continual improvement.' (Fonseca 2015.) Literature regarding these aspects of quality control is examined through the lens of Self Determination theory.

Assessment and auditing

Self-determination theory suggests that autonomy supportive environments will enable workers to internalise rules and regulations that are meaningful for them (Gagne and Deci 2005). Inappropriate quality control could lead to audit and assessment rules and procedures which are seen to be excessive, time wasting, paper

pushing, meaningless, and distracting from the 'real' job. In this case, does the assessment process reduce the employee's perception of autonomy?

McCabe and Boyd (2004, 874) find extensive ‘quality initiative fatigue’ in construction organisations, reporting that “QA is seen as a bureaucratic imposition of the companies' lack of trust in them as people”. Adopting standardised systems involves giving up an amount of control and freedom of choice (Brunsson 2000). Brunsson observes “Standardisation is often seen as an unwelcome, unnecessary, and harmful intrusion into a world of free, distinct individuals and organisations that are wise enough to decide for themselves...” (2000, 171). In construction, Abdul - Rahman (1997) finds considerable resistance to the imposition of quality management procedures where workers exploit ‘loopholes’ in quality management systems to their own benefit. Morgan (2006:38) observes that "social, cultural and political resistance" is mobilised against business programs which emphasise the technical system at the expense of all other considerations. Adler and Borys (1996) divide formalised regulation into two categories: enabling and coercive. Coercive bureaucracy is stifling, forcing compliance, limiting innovation, contributing to power asymmetry, job dissatisfaction and stress. Conversely, they argue that enabling regulation can support employees, becoming a useful tool to enable them to innovate, to increase their performance and job satisfaction levels.

In the financial world, David Weinberger (2007) suggests that managers are fooled by two lies: that systems fail due to individual performance, and that these individuals can be controlled, if only the right tools can be found. The superstition of 'accountabalism' leads to more forms, more tick boxes, more control, and “makes work no fun.” Christ *et al*., (2012) find that preventative control in the financial sphere reduces intrinsic motivation, which results in reduced performance of a task. Implementing ISO 9001 quality management forces workers to become 'part of the system,' categorising employees as a resource, alongside equipment and money (de Vries and Haverkamp 2015). Work environments focussed on external control and regulation shift the workers’ perceived locus of causality to an external one. The workers become less interested in the work itself, but are focused on meeting targets and avoiding subsequent penalties (Ryan and Connell 1989; Gagne and Deci 2005). Perceptions of autonomy and competence are reduced and the temptation to game the system for individual benefit is increased (Gagne and Deci 2005). Researchers must stop taking quality management at face value as a 'good thing.' Sampaio *et al*., (2012) controversially find that ISO 9001 accreditation may not increase a company's profitability, in fact implementation can be detrimental to a company's performance (Martinez Costa and Martınez-Lorente 2007).

Feedback

Inappropriate feedback may focus on the negative, find fault with performance and undermine an individual's sense of competence. Quality management systems focus on non-conformances in an attempt to reduce or eliminate non-compliant work (Burati *et al*., 1992). Feedback is an "instrument of discipline" (de Vries and Haverkamp 2015: 21). Negative feedback diminishes intrinsic motivation (Deci *et al*., 1973). Workers' feelings of competence are undermined as their output is picked over for faults, which decreases a subject’s sense of competence and autonomy potentially leading to amotivation (Gagne and Deci 2005). Deci Koestner and Ryan’s 1999 meta-analysis of self-determination research finds support for the proposition that even positive feedback reduces intrinsic motivation.

Hoffman (2015) looks at the balance between supervision and autonomy amongst medical trainees, constructing an argument that autonomy can be promoted within high risk environments that require close supervision. He advocates that supervision be seen as 'scaffolding' to enable learners to progress and become independent. This scaffolding is dependent on the individual situation, adaptable, temporary, and progressively removed as it is no longer required. Several factors impact on the benefits of feedback: the perceived honesty of the feedback and the credibility of the person giving it, if the challenge is realistic and achievable, and if it uses improvement against previous performance rather than comparison with colleagues (Henderlong and Lepper 2002). Ten Cate (2013) discusses feedback given to medical students. Although essential for problem correction, only 17% of students rated the feedback they were given as effective. 91% of those giving feedback felt that the feedback was effective, suggesting that feedback is much easier to give than to take. Ten Cate contends that receiving feedback tends to reduce feelings of competence, autonomy and relatedness. Competence, as feedback is usually structured to correct a deficiency. Autonomy, because the subject usually has not requested the feedback and has little say in its content and manner of delivery. Relatedness, because the subjects of the feedback are trying to prove their worth and be accepted as competent.

Continual improvement (or continued deception)

Unrealistic or unworkable targets for improvement generated by quality audits may undermine perceived competence and lead to deception and concealment. In software development, Ford and Sterman (2003) find that designers and managers display behaviour which is rational to the individual in the short term, but creates problems at a project and organisational level in the long term - that is, minimising, under reporting and covering up problems and defects. Covering up problems to buy time, in the hope that more problems generated by others occur in the meantime, is common practice according to this study. The reasons for the deception include to temporarily reduce rework, to avoid responsibility for mistakes and schedule slippage, maintain apparent programme and enhance job security and authority. Unrealistic expectations, for instance overly optimistic programme assumptions, create the perfect environment for deception. Van Kemenade *et al*., (2011) find that willing implementation of quality system by university staff is contingent on several conditions being met, amongst them the fact that quality experts should not 'take over', that the rules are simple and that control is not a dominant aspect of the system. If these conditions are not met, they noted "dramaturgical compliance" -the staff will 'game' the system, pretend to comply and try to fool the auditor. This concurs with Stone Deci and Ryan's (2009) assertion that carrot and stick methods of control can lead to poor quality and deception. It is easy to cover up problems on a construction site, or correct them before they can be noted by senior management. Hence the root causes of such defects are not fixed (Arditi and Gunaydin 1997). Even where concealment may not be in play, construction managers tend to be optimistic when reporting progress, programme and quality in order to present a good 'face.' ISO 9001 quality management requires proof of 'continual improvement.' Under sometimes unrealistic expectations, it is likely that concealment, deception and exaggeration occur during quality audits; this is confirmed by the personal experience of the authors.

Lean construction and Total Quality Management (TQM)

Lean and TQM systems take the principle of quality and extend it across all business processes and systems (Burati *et al*., 1992). Often the obsession with process and system has little consideration for people. Styhre (2001) suggests that empowering

workers is antithetical to Kaizen. In kaizen, the individual employee, his needs and goals are subjugated to the needs and goals of the organisation. Toyota profess a policy of 'respect for people.' However, (Green 1999, 1) suggests that lean techniques entail “control, exploitation and surveillance”, and describes the human cost of lean production as increased stress under pressure to meet targets.

DISCUSSION

Why does this matter?

Van den Broeck *et al*., (2010) link high levels of autonomous motivation to greater job satisfaction, enthusiasm, and lower levels of stress and burnout. Grabner and Speckbacher (2010) suggest that complex and unpredictable creative work requires intrinsic motivation, which can be undermined by inappropriate rules, standards and controls. Disengagement at work leads to lower productivity, profitability, job growth and share price (Cappelli 2015). Gagne and Deci (2005) connect environments which support autonomy, competence and relatedness (hence fostering internalised extrinsic motivation), with creativity, effective performance, positive work environments and psychological well-being. Commitment to an organisation increases in relation to an increase in autonomous motivation (Gagne *et al*., 2004). Autonomous motivation is a powerful driver for performance enhancement in business, however this enhancement does not come at the expense of the workers; in fact, if harnessed it will generate a healthier, happier, and more satisfied workforce.

Claim for knowledge

This study examines issues of control and regulation from the perspective that people can exercise autonomy and free will, where autonomy is essential for psychological health, and influenced by the social context. The Foucauldian approach finds that autonomy is restricted by power systems and society, and looks at issues on a system and societal level. Self-determination theory looks at matters at the level of the individual and collates findings into a collective response.

Foucauldian analysis of control and regulation has considered identity regulation as a means of control (Alvesson and Willmott 2002); the 'reification' of systems of control (Hodgson and Cicmil 2007); and self-subjugation, 'performativity' and parody, in response to control (Hodgson, 2005). Clegg *et al*., (2002) describe the tension between control and autonomy when managers 'freed' from bureaucracy found themselves more constrained than before with a self-generated set of controls. Attempts at identity control can lead to cynicism and can backfire (Alvesson and Willmott 2002). This study has found that overbearing quality control can impact on individuals' sense of autonomy, competence and relatedness. Its aim is to examine quality control and identify ways in which it might be changed to harness employees' autonomous motivation. This study and subsequent research must take care to avoid the pitfalls identified by the Foucauldian studies. It must avoid engendering the sort of initiatives described by Alvesson and Willmott (2002) as hype or intrusive regulation, or to further bind employees in constraining, self-constructed regulation (Clegg *et al*., 2002) using self-actualisation as a cynical means to engineer compliance with corporate goals.

CONCLUSION

People matter. Workers and managers must be more than simply a cog in a machine. At the same time, construction management needs some control in order to deliver

projects safely in an unpredictable environment. A balance must be reached between too much control and too little.

The aim of this research is to examine the relationship between quality control and motivation through the framework of Self-determination Theory. The initial findings are that excessive control can undermine autonomous motivation by creating a perceived external locus of causality. Unworkable targets, unnecessary paperwork and irrelevant auditing can create an environment in which deception and concealment flourish. It is difficult to give effective feedback: if given in a controlling manner and focussed on faults it can diminish intrinsic motivation. These factors can undermine the worker's sense of autonomy, competence and relatedness leading to a reduction in autonomous motivation. Bureaucratic, controlling quality management with unrealistic expectations, excessive paperwork and negative feedback, can do more harm than good.

The hypothesis that quality control can demotivate workers and undermine their feelings of competence, autonomy and relatedness has been formed through the examination of existing self-determination, motivation, management and quality management literature. This critical review has explored the research question; however, a comprehensive answer is not possible within the constraints of this conference paper. In order to fully answer the research question and determine issues relating to motivation and quality control in construction, further research is needed. The impact of control on motivation in the construction industry should be studied through research in the field, in order to identify and implement improvements in practice to ensure that workers are productive, engaged and psychologically healthy.

REFERENCES

Abdul-Rahman, H (1997) Some observations on the issues of quality cost in construction. *International Journal of Quality & Reliability Management*, **14**(5), 464-481.

Adler, P S and Borys, B (1996) Two types of bureaucracy: Enabling and coercive. *Administrative Science Quarterly*, **41**(1), 61-89.

Alvesson, M and Willmott, H (2002) Identity regulation as organizational control: Producing the appropriate individual. *Journal of Management Studies*, **39**(5), 619-644.

Arditi, D and Gunaydin, H M (1997) Total quality management in construction. *International Journal of Project Management*, **15**(4), 235-243.

Brunsson, N (2000) The pros and cons of standardization: An epilogue. *In*: N Brunsson and B Jacobsson (Eds.) *A World of Standards*. Oxford: Oxford University Press, 169-173.

Burati, J L, Matthews, M F and Kalidindi, S N (1992) Quality management organizations and techniques. *Journal of Construction Engineering and Management*, **118**(1), 112-128.

Cappelli, P (2015) Why we love to hate HR...and what HR can do about it. *Harvard Business Review*, July-August 2015, 55-61

Christ, M H, Emett, S A, Summers, S L, Wood, D A (2012) The effects of preventive and detective controls on employee performance and motivation. *Contemporary Accounting Research*, **29**(2), 432-452.

Clegg, S, Pitsis, T, Rura-Polley, T, & Marosszeky, M (2002) Governmentality matters: Designing an alliance culture of inter-organizational collaboration for managing projects. *Organization Studies*, **23**(3), 317-337.

de Vries, H J and Haverkamp, A (2015) Overcoming resistance against quality control: A philosophical-empirical approach. *International Journal of Quality & Reliability Management*, **32**(1), 18-41.

Deci, E L Koestner, R, and Ryan, R M (1999) A meta-analytic review of experiments: Examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin*, **125**(6), 627-668.

Deci, E L (1975) *Intrinsic Motivation*. New York: Plenum.

Deci, E L and Cascio, W F (1972) Changes in intrinsic motivation as a function of negative feedback and threats. *In*: *Meeting of the Eastern Psychological Association, April 19 1972, Boston Massachusetts*.

Deci, E L and Ryan, R M (2000) The what and why of goal pursuits: Human needs and the self-determination theory. *Psychological Inquiry*, **11**(4), 227-268.

Deci, E L and Ryan, R M (2011) Levels of analysis, regnant causes of behavior and well-being: The role of psychological needs. *Psychological Inquiry*, **22**(1), 17-22.

Deci, E L, Cascio, W F and Krusell, J (1973) Sex differences, verbal reinforcement, and intrinsic motivation. *In*: *Meeting of the Eastern Psychological Association, May 1973, Washington DC.*

Dick, G P M Heras, I and Casadesús, M (2008) Shedding light on causation between ISO 9001 and improved business performance. *International Journal of Operations & Production Management*, **28**(7), 687-708.

Fonseca, L M (2015) ISO 9001 Quality Management through the lens of organizational culture. *Quality Management*, **16**(148), 54-59.

Ford, D N and Sterman, J D (2003) The Liar's Club: Concealing rework in concurrent development. *Concurrent Engineering*, **11**(3), 211-219.

Fry, L W (1976) The Maligned FW Taylor: A Reply to His Many Critics. *Academy of Management Review*, **1**(3), 124-129.

Gagné, M and Deci, E L (2005) Self-determination theory and work motivation. *Journal of Organizational Behavior*, **26**(4), 331-362.

Gagné, M, Boies, K, Koestner, R and Martens, M (2004) *How Work Motivation Is Related To Organizational Commitment: A Series of Organizational Studies*. Manuscript, Concordia University.

Grabner, I and Speckbacher, G (2010) How to control creative work: The role of intrinsic motivation and task programmability in control system design. *Academy of Management*, (1), 1-6.

Green, S D (1999) The dark side of lean construction: exploitation and ideology *In*: I D Tommelein (Ed.) *Proceedings of International Group for Lean Construction, 26-28 July 1999, University of California, Berkeley, CA*, Vol 7, 21-32.

Henderlong, J and Lepper, M R (2002) The effects of praise on children's intrinsic motivation: A review and synthesis. *Psychological Bulletin*, **128**(5), 774.

Hodgson, D (2005) ‘Putting on a professional performance’: Performativity, subversion and project management. *Organization*, **12**(1), 51-68.

Hodgson, D, & Cicmil, S (2007) The politics of standards in modern management: Making ‘The Project’ a reality. *Journal of Management Studies*, **44**(3), 431-450.

Hoffman, B D (2015) Using self-determination theory to improve residency training: Learning to make omelettes without breaking eggs. *Academic Medicine*, **90**(4), 408-410.

McCabe, S and Boyd, D (2004) Quality management 25 years on: What can we learn about initiatives in construction? *In*: F Khosrowshahi (Ed.) *Proceedings of 20th Annual ARCOM Conference, 1-3 September 2004, Heriot Watt University, UK*. Association of Researchers in Construction Management, Vol 2, 867-73.

McKinlay, A Carter, C Pezet, E and Clegg, S (2010) Using Foucault to make strategy. *Accounting, Auditing & Accountability Journal*, **23**(8), 1012-1031.

Martínez-Costa, M and Martínez-Lorente, A R (2007) A triple analysis of ISO 9000 effects on company performance. *International Journal of Productivity and Performance Management*, **56**(5/6), 484-499.

Morgan, G (2006) *Images of Organization*. Thousand Oaks, CA: Sage Publications.

Pinder, C C (2008) *Work Motivation in Organizational Behavior*. New Jersey: Prentice-Hall.

Riketta, M and Van Dick, R (2005) Foci of attachment in organizations: A meta-analytic comparison of the strength and correlates of workgroup versus organizational identification and commitment. *Journal of Vocational Behavior*, **67**(3), 490-510.

Ryan, R M and Connell, J P (1989) Perceived locus of causality and internalization: Examining reasons for acting in two domains. *Journal of Personality and Social Psychology*, **57**, 749-761.

Ryan, R M and Deci, E L (2000) Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, **55**, 68-78.

Sampaio, P Saraiva, P and Monteiro, A (2012) ISO 9001 certification pay-off: myth versus reality. *International Journal of Quality & Reliability Management*, **29**(8), 891-914.

Stone, D N, Deci, E L and Ryan, R M (2009) Beyond talk: Creating autonomous motivation through self-determination theory. *Journal of General Management*, **34**(3), 75-102.

Styhre, A (2001) Kaizen, ethics, and care of the operations: Management after empowerment. *Journal of Management Studies*, **38**(6), 795-810.

Taylor, F W (1947) *Scientific Management*. New York and London: Harper and Row.

Ten Cate, O T J (2013) Why receiving feedback collides with self-determination. *Advances in Health Sciences Education*, **18**(4), 845-849.

Till, J (2007) Architecture and contingency. *Field*, **1**(1), 120-135.

Van den Broeck, A, Vansteenkiste, M, Witte, H, Soenens, B, and Lens, W (2010) Capturing autonomy, competence, and relatedness at work: Construction and initial validation of the Work-related Basic Need Satisfaction scale. *Journal of Occupational and Organizational Psychology*, **83**(4), 981-1002.

Van Kemenade, E A, Hardjono, T W and De Vries, H J (2011) The willingness of professionals to contribute to their organisation's certification. *International Journal of Quality and Reliability Management*, **28**(1) 27-42.

Weinberger, D (2007) The folly of accountabalism. *Harvard Business Review*, Feb 2007.

Wong, J (2010) Foucault and autonomy. *Archiv fuer Rechts-und Sozialphilosphie*, **96**(3), 277-290.

EXTERNAL FAILURE COST IN CONSTRUCTION SUPPLY CHAINS

Diyana Syafiqah Abd Razak[1], Grant Mills and Aeli Roberts

Bartlett School of Construction and Project Management, University College London, 2nd Floor, 1-19 Torrington Place, London, WC1E 6BT, UK

The effective measurement of cost of quality has an important role to play in driving quality. A handful of studies on the implementation of cost of quality in the construction industry have been undertaken with a good deal more published in other sectors. Cost of quality definitions, methods, and models are reviewed. The aim of this research is to understand how the complex interrelationships of construction supply chain members may influence the existence of external failure cost. A new study that focuses on the measurement of external failure cost during the post-handover stage of construction is proposed. An expert workshop and a trial questionnaire involving construction industry experts (both owners and their supply chains) show the various categorisations of external failure quality cost elements and the involved and compound nature of their measurement through the construction supply chain. Further research is proposed to appraise, quantify and align incentives and ultimately reduce the occurrences of failure.

Keywords: cost of quality, external failure cost, supply chain

INTRODUCTION

Cost of quality (COQ) was first introduced in the early 1950s in Juran's Quality Control Handbook (Yang, 2008) and has become part of the business strategy of many firms (Tye *et al*., 2011) to benchmark, drive continuous improvement and increase profit (Jaju *et al*., 2009). The application of COQ is well established in the manufacturing industries, but not in construction (Aoieong *et al*., 2002). While various theoretical forms of studies have defined and described the need to measure COQ failure, none have explored it against the complexity of the construction supply chain.

Various applications of the COQ in the construction industry have demonstrated tangible savings. For example, Abdul-Rahman (1996) found that tender value could be reduced by 5.6% through the prevention of non-conformance cost. While Hall and Tomkins (2001) found 5.48% failure cost savings and 12.68% prevention and appraisal cost savings. Tang *et al*., (2004) showed significant increases in COQ savings could be made when learning was applied between consecutive projects. There appears to be no construction specific approach to COQ and the complexity of the construction sector makes it difficult to translate practices from elsewhere (Jaafari and Rodchua, 2014). Instead, construction enterprises best existing project costing systems or perform bespoke investigations of specific quality failures that are dyadic

[1] diyana.razak.14@ucl.ac.uk

Razak, D S A, Mills, G and Roberts, A (2016) External Failure Cost in Construction Supply Chains. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 833-842.

in their relationship between two parties and so closed to wider learning, There is still significant work to be done to classify and spread good COQ practices.

Failure cost is highly recurrent in construction projects (Avendano Castillo *et al*., 2010), albeit rarely empirically investigated. According to Basu (2014) projects delivering on time and within budget, often fail to meet the end users' expectations in operation. Recent research by the Standish Group found that 98.9% of the projects in their database failed (*ca.* 49,450 projects) against one of cost, time, value, scope, customer satisfaction and strategic objective criteria. Examples of post-project failures are widespread. In the UK an air traffic control centre was ten years over schedule and still required reworks a year after opening (BBC, 2002). Berlin's Brandenburg airport was not functionally fit for purpose resulting in significant cost overruns and time delays from its 2011 opening. The significance of this work is that although there are definitions, methods, and categorisation of COQ, there has been little elaboration of the quantifying failure cost relationships post-handover. This article will thus address this gap and appraise the existence of external failure cost against a complex construction supply chain.

Defintion of Cost of Quality (COQ)

The COQ is known as the price of not creating a quality product or services. According to Krishanan *et al*., (2000), quality costs are the costs incurred to prevent shortfall in quality and failure to meet customer requirements. Accordingly, the COQ is simply a cost absorbed due to the work requisite in achieving targeted quality in a project. It is either cost to achieve the quality or a cost due to quality failure. As such, it cannot be ignored.

Quality cost was first propounded by Juran (1951) and later developed by Crosby (1979, 1983 and 1984). Quality was known as the conformance to requirement, but it was Crosby (1979) who elaborated quality cost to see it as both the price of conformance (cost invest to comply with requirement) and price of non-conformance (cost of poor quality). Feigenbaum (1991) later redefined these categorisations as the cost of control (cost of conformance) and costs of failure of controls (costs of non-conformance). Schiffauerova and Thomson (2006) included the additional cost due to the failure in achieving customer requirements (such as correcting, reworking or scrapping). All are simply the total costs that are avoidable (Al-Tameemy *et al*., 2012). Ali *et al*., (2010) differentiated between internal failure cost (the costs incurred before delivery to the owner) and external failure cost (after delivery to the owner).

COQ has previously been consistently classified into three main categories: Prevention, Appraisal, and Failure (Feigenbaum, 1956), according to the timing of its occurrence. Better known as the "Prevention-Appraisal-Failure" (PAF) model (Abdul-Rahman, 1996; Aoieong *et al*., 2002; Jaafari and Rodchua; 2014). The relationship between quality cost elements for construction has been depicted in a new model developed in collaboration with the Chartered Quality Institute (Figure 1), and being trialled by the authors.

Despite the general classifications model of COQ being implemented, some have expressed scepticism on the overall coverage of this traditional categorisation (Yang, 2008; Dahlgaard *et al*., 1992), with those such as Yang (2008) and Krishan (2006) referring to the "hidden" nature failure costs. While there are sceptics, however, no better alternative exists. Quantification will almost certainly help to benchmark and see the causality between costs. The increased and controlled cost of prevention and appraisal will lead to the decrease in internal and external failure costs (Kiani *et al*.,

2009). So the central tenant of the P-A-F model is an investment in prevention and appraisal activities which will reduce failure costs, and further investment in prevention activities accordingly will reduce appraisal costs (Roden and Dale, 2001).

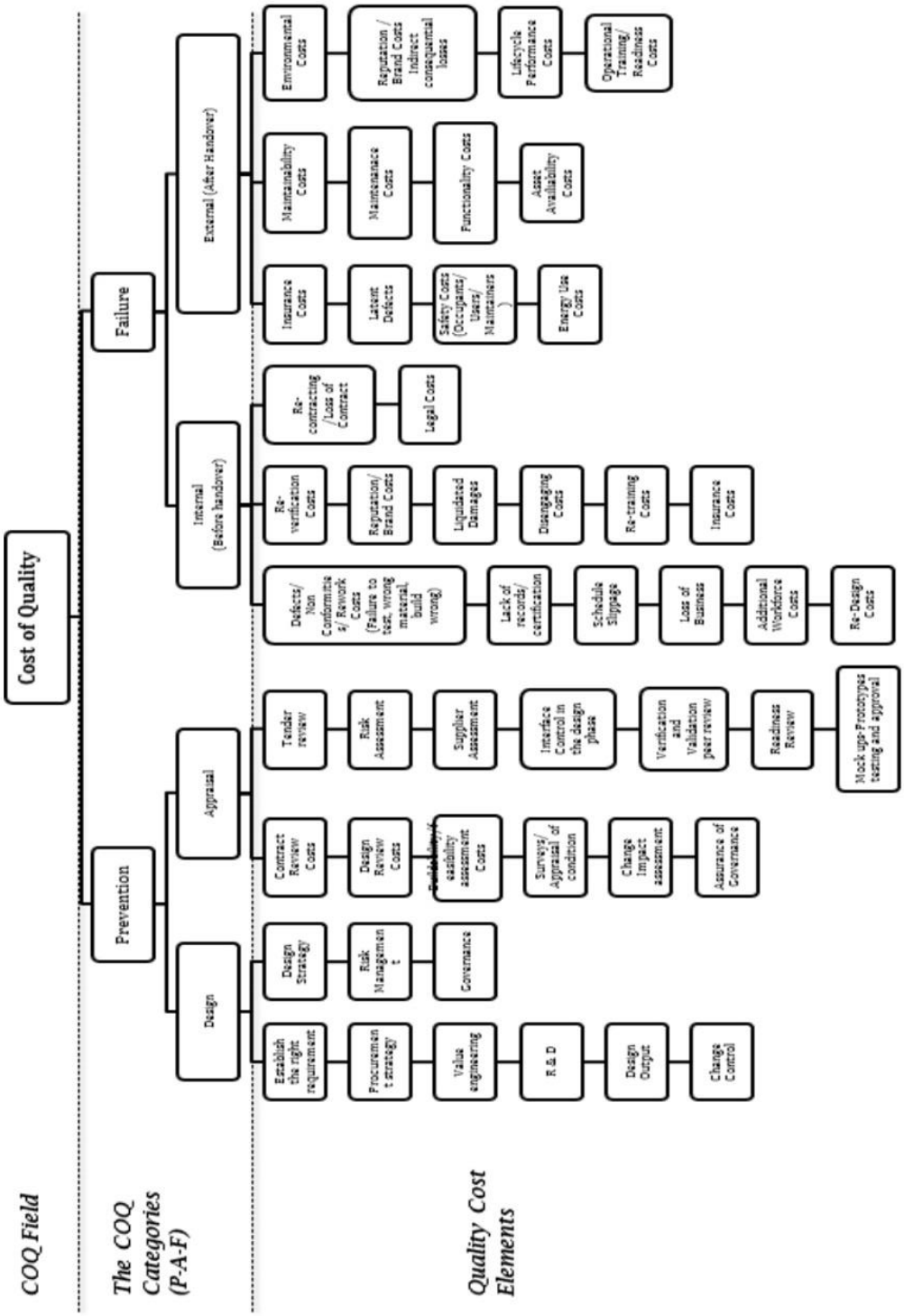


Figure 1: The COQ field and classification of quality cost elements

Focus on Cost of Quality failure

Failure is a lack of success, falling short, or omission of some persons, processes or products. Many academic authors associate insufficient planning and control with project failure (e.g. Dvir *et al*., 2003b and Lechler *et al*., 2015), although projects are

complex, time restricted and unique endeavours that have often not been implemented before; consequently changing plans are inevitable to accommodate for the uncertainties (Andersen, 1996).

While there are consensuses in the literature on measuring COQ, research on failure cost is fragmented. Models have been suggested to measure failure, but none are developed for construction (Taggart, 2014), however specific quality costs have been investigated, for example defective works (Mukhopadhyay, 2004), deficient work (Freiesleben and Freiesleben, 2005) or the consequence of rework (Castilo and Helman, 2010).

Yang (2008) defined failure as "visible" and "hidden" cost. Typically, external failure costs are hidden costs - comprising such elements as insurance, maintainability and environment costs. External failure costs are considered to be the most significant quality cost and more difficult to evaluate than other categories (Snieska *et al*., 2013). Love and Irani (2002) believes that costs could be 25% of the total construction process. While Taggart *et al*., (2014) suggested rework cost range from 2% to 6% during construction and additionally 3% to 6% during maintenance period. Prevention and appraising external failure cost has yet to be empirically investigated in construction.

Application of measures

Ozkan and Karaibrahimoglu (2012) have identified classification and measurement steps, although accuracy and information misreporting can be a problem (Omar and Murgan, 2014, Yang, 2008), with traditional cost accounting systems known to fail (Ozkan and Karaibrahimoglu, 2012; Yang, 2008; Tsai, 1998). There is huge variability in standards and guidelines for measuring quality costing, and skills and training in measuring COQ are needed (Jafari and Rodchua, 2014) to avoid error (Barber, 2000).

Some believe there must be a dynamic and constantly changing measure of COQ and the measures must be organisationally specific (Srivastava, 2008, Hwang and Aspinwall, 2010) and cover the breadth of an organisations operation and the needs and requirements of customers (Dale *et al*., 2007). However, standardisation is needed to facilitate benchmarking and continuous improvement (Miguel and Pontel, 2003).

Miguel and Pontel (2003) state quality failure is due to ineffective and unsystematic capture of quality costs, with external failure costs absorbed by one party or shared among the supply chain. While, most studies only indicate basic guideline in failure cost (Dror, 2009; Snieska, 2013), there is little consistent and credible quality cost data (Kumar *et al*., 1998) and mechanisms are judged by some to be ineffective (Miguel and Pontel, 2003). Research on how owners and their construction supply chain form relational and technical systems to measure and address external failure cost are therefore imperative.

METHODOLOGY

Two studies investigated the status of failure cost during post-handover. Study 1 was a workshop held to categorise external failure cost elements. The participants were construction industry experts (a quality manager, quality consultant, two contractors, and owner) within different sectors of project-based firms (n=5). A card sorting

methodology (Jahrami 2012) was used to classify the quality cost elements (e.g. to show dependence and interrelatedness). Participants were first asked to indicate through sorting) which organisation positions accrued costs related to each external failure cost element (based on their experience), then think about how groups could be categorised.

Study 2 was a survey that investigated the respondent experience of external failure cost issues, enterprise maturity in COQ and to understand various owner and supplier influences on external failure. Data were collected from 15 respondents with advisors (*n*=2), suppliers (*n*=3) main contractors (*n*=2) and owners (*n*=7) in UK construction industry who mostly had responsibility multiple assets (rather than a single one off project) and the value of these assets ranged from £400m to £5billion per annum.

FINDINGS

Study 1 finding from an expert workshop to categorise failure cost

The analysis of the card sorting showed two key findings for the nature of external failure cost within the supply chain.

All external failure cost elements are partially incurred by the owners / operator followed by integrator / main contractor and advisor/ consultant/designer. One outlying expert perceived cost shared throughout the supply chain. Discussion of this fact between the experts showed that the difficulties in quantifying external failure costs during the operation of the assets. This shows that most cost is absorbed as part of day-to-day operational costs. Each organisation may not be aware of the occurrences of these costs, as it is assumed to be only incurred by the owners. Thus, the total amounts of external failure cost are anonymous or only suffered by one party.

The external failure costs were categorised and incurred differently by various members of the owner and supply chain. For example Insurance cost was most frequently incurred by the whole supply chain, while obsolescence cost was the least frequently incurred. Each expert (who had a different role) produced different categorisation of external failure cost elements, according to when they are identified or occur in time, or according to the risk owner or who they are incurred by (e.g. to the owner, supply chain or shared). This was otherwise described as those that are impacted.

Study 2 findings from the application of a trial COQ questionnaire

The results show that the maturity of enterprises in dealing with these external failure cost elements differed significantly. Measurement and management of quality cost element was judged by respondents to be insufficient, with relatively low maturity expressed. The results in table 1 show how owners (O) and their supply chain (S) judge their own maturity. There were limited expressions of maturity (at a level of "managed" or "optimised" experience. Most elements were at best understood (e.g. at a "defined" level or lower). Perhaps most interesting was "insurance" where there was significant misalignment within and between owners and suppliers. However, it was also judged to have the highest level of maturity, which may illustrate its management. This shows variances between owners and supply chain maturity may be due to insufficient information upon the element. There is some variation between suppliers on the maturity of "safety", "asset availability" and "energy use" (with scores ranging from unaware to managed), perhaps more than between owners. It is difficult to say why this may be, and so why suppliers vary more significantly in their maturity should be further investigated. There is strong alignment between both

owners and suppliers, with most aligned maturity on “operational training”, “environmental”, and “lifecycle performance”. There was owner and supplier alignment on some elements with least maturity (including “adaptability”, and “Early obsolescence”). There was a moderate level of awareness on “latent defects” and “maintenance”.

Table 1: Owner (O) and supply chain (SC) level of maturity in measuring external failure cost elements

Level of maturity	Failure cost elements: Insurance		Latent Defect		Safety		Asset availability		Energy use		Maintenance		Environmental		Lifecycle performance		Functionality		Unadaptable		Early obsolescence		Reputation		Operational Training	
	O	S	**O**	S	**O**	S	**O**	S	**O**	S	**O**	S	**O**	S	**O**	S	**O**	S	**O**	S	**O**	S	**O**	S	**O**	S
Unaware	**4**	1	**1**		**3**	2	**2**	3	**2**	1	**2**	2	**2**	1	**1**	1	**4**	2	**4**	3	**4**	3	**3**		**2**	1
Aware	**1**	2	**4**	5		2	**2**	2	**2**	2	**3**	4	**2**	3	**4**	3	**1**	2	**2**	1	**2**		**2**	3	**1**	3
Defined		2	**1**	2	**2**	2	**1**	2	**3**	2	**1**	2	**2**	3	**1**	3	**1**	3	**1**	2		3		2	**3**	3
Managed	**2**	3		1	**2**	2	**1**	1		3	**1**		**1**		**1**		**1**			1	**1**	1	**1**	2	**1**	
Optimising			**1**				**1**																			

Respondents frequently differed on how they rated their own maturity versus that of others with the maturity of the supply chain judged to be the lowest. Both owners and supply chain saw their own level of maturity as above fair (e.g. fair, good or very good). When judging the customer, there is an agreement on the level of maturity to influence operational failure as good, but few say it is below fair (either very low, low or fair). In judging suppliers, most owners and supply chain indicates moderate maturity (ranging from fair, low or very low), although the supply chain score themselves and other suppliers as good. In judging the ability to influence, owners and supply chain both agreed they are beyond fair (fair, good and very good). Table 1 and 2 shows that the level of maturity of the owner and supply chain in dealings with quality cost elements is understood but not managed, however there are great confidence in the ability to influence operational failure. Thus, increments in the maturity towards quality cost elements help greater managerial and measurement of the quality cost. It is believed to depreciate the occurrences of external failure cost with more integrated system of quality costing.

Table 2: The level of maturity in influencing operational failure ascribed to the Owner (O) and supply chain (S)

Level of maturity	Own Enterprise		Customers		Suppliers		Overall ability to influence	
	O	SC	**O**	SC	**O**	SC	**O**	SC
Very Low			**1**	1	**1**			
Low		2		1	**2**	2		
Fair	**4**	2	**2**	1	**2**	3	**3**	5
Good	**1**	2	**3**	4	**1**	2	**1**	2
Very good	**1**	1					**2**	

These findings may be explained by participants’ qualitative comments. There was a belief that the owner role was unclear in dealing with failure cost, and that there was a need for strong owner leadership. There was perceived to be poor standards in place and a lack of knowledge on what defines value. Also there was weak understanding of a projects context, and some acceptance to acceptance of non-performance. There was also a need for rigorous assurance during design and construction, change and

scope control and clear definition of operational requirement pre-project to reduce the failure cost during operational. These require greater investigation.

DISCUSSION

Most organisations have different ways to capture the COQ (Yasamis *et al*., 2001), thus there is a need to align and standardise measurement through the supply chain. There is a need to understand the contextual and organisational differences between projects with regards to COQ measures (Shiffauerova and Thomson, 2006), and this initial study indicates that maturity within industry is relatively low. Quality cost is believe as an exchange/transition cost, although more research is needed to understand the relationships and shared responsibility that will contribute to learning. External failure cost may be classified in different ways in different projects and sectors and there are variations in owner and supply chain maturity and influence.

Snieska *et al*., (2015) recommend steps in order to reduce external failure cost through quantification and observation during the process. There are variations in COQ models (Omar and Murgan, 2014), although no existing models are suitable. Most of the research effort has focused on identifying quality cost elements, calculating COQ, reducing the costs and the relationship between cost component during the prevention and appraisal. This paper contributes to the field of quality cost management by looking into the relationship of construction supply chain in appraising external failure cost.

There is a known benefit in visualising hidden costs, and in monitoring and quantifying (in financial terms) the effects of poor quality (Hwang and Aspinwall, 1996 and Jafari and Rodchua, 2014). Studies 1 and 2 have shown the need for industry measurement and management of failure costs because there is a lack of full maturity and uncertainty on owner and supplier influence. As in Porter and Ryner (1992) it is hoped that this work will facilitate quality management improvement and help to eliminate waste, and point out the strengths and weaknesses of a quality system (Srivastava, 2008). It is hoped that understanding COQ deficiencies will help to define the quality programme (Yang, 2008), lead to time and costs savings (Love and Li, 2002, Tang *et al*., 2004), enhance profit sustainability (Paleneshwaarran, 2006), reduce customer dissatisfaction and reduce lost reputation during the period of maintenance and operation (Devi and Chitra, 2013), and allow for immediate corrective actions (Love and Irani, 2002).

CONCLUSIONS AND RECOMMENDATIONS

External failure cost is recognised as the cost incurred after the asset is handed over to the owner. Due to the complexity of project handover there are still costs accrued by the supply chain. Many costs are either recognised, found lost in the process or ignored or absorbed as an overhead by one party or another, who is willing to take the responsibility. This shows the difficulties in measuring COQ in construction.

The measurement of the external failure cost has not been well explored in the academic literature and within the sample of construction industry owners and supply chain representatives, there was seen to be a low or at best a moderate levels of maturity. Ability to influence operational failure appears very clear; that operational failure is not a result of an independent parties but it is the result of interaction between many interrelated supply chains represented by different failure factors.

This paper has combined existing literature with an initial research trial to show that further research is needed to underpin knowledge of external failure costs. This initial step shows the complexity in understanding quality costs and the limited maturity in capturing data due to the distribution of responsibilities throughout the supply chain. This raises important questions, such as in what proportions are these costs shared? How can relationships and technical systems be managed to reduce quality failure? And how can improvements in external failure cost measured? Action research in one major infrastructure organisation is undertaken to elaborate on these findings.

REFERENCES

Abdul-Rahman, H, Thompson, P A and Whyte, I L (1996) Capturing the cost of non-conformance on construction sites: An application of the quality cost matrix. *International Journal of Quality and Reliability Management*, **13**(1), 48-60.

Al-Tmeemy, S M H, Rahman, H A- and Harun, Z (2012) Contractors' perception of the use of costs of quality system in Malaysian building construction projects. *International Journal of Project Management*, **30**(7), 827-838.

Ali, M C, Zin, R M, Hamid, Z A, and Ayub, A R (2010) Quality Cost in the Construction Industry: Preliminary Findings in Malaysia, *Journal of Design and Built Environment*, **6**(3), 29-43.

Aoieong, R T, Tang, S L, and Ahmed, S M (2002) A process approach in measuring quality costs of construction projects: Model development. *Construction Management and Economics*, 20(2), 179-192.

Barber, P, Graves, A, Hall, M, Sheath, D, Tomkins, C, Barber, P and Yeo, H K C (2006) Quality failure costs in civil engineering projects. *Journal of Quality and Reliability Management*, **17**(4/5), 479-492.

Basu, R (2014) Managing Quality in Projects: An empirical study, *International Journal of Project Management*, **52**(1), 178-187.

Avendano Castillo, J E, Al-Jibouri, S H, and Halman, J I M (2010) Underlying mechanisms of failure costs in construction. *Challenges, Opportunities and Solutions in Structural Engineering and Construction*, 939-944.

Crosby, P B (1979) *Quality is free: The art of making quality certain*. London: McGraw-Hill.

Dahlgaard, J J, Kristensen, K and Kanji, G K (1992) Quality costs and total quality management. *Total Quality Management*, **3**(3), 211-222.

Dale, B G, Wiele, T V D and Iwaarden, J V, (2007) *Managing Quality 5th Edition*. Oxford: Blackwell Publishing.

Devi, P I and Chitra, G (2013) Cost of quality in construction industry. *Journal of Rural and Industrial Development*, **1**(1), 44-49.

Feigenbaum, A V (1991) *Total Quality Control 3rd Edition*. New York: McGraw-Hill.

Feigenbaum, A V (1956) Total Quality Control. *Harvard Business Review*, **34**(6), 93-101.

Freiesleben, J, and Freiesleben, J (2005) The opportunity costs of poor quality. *The Quality Assurance Journal*, **9**(1), 3-10.

Hall, M, and Tomkins, C (2000) A cost of quality analysis of a building project : Towards a complete methodology by Agile Construction Initiative. University of Bath School of Management Working Paper Series.

Hwang, G H and Aspinwall, E M (1996) Quality cost models and their application: A review. *Total Quality Management*, **7**(3), 267-282.

Jafari, A, and Rodchua, S (2014) Survey research on quality costs and problems in the construction environment. *Total Quality Management*, **25**(3-4), 222-234.

Jahrami, H (2012) Card sort methodology: An objective measure in rehabilitation research. Journal of Rehabilitation Research Development, **49**(2), vii-viii.

Jaju, S B, Mohanty, R P and Lakhe, R R (2009) Towards managing quality cost: A case study. *Total Quality Management and Business Excellence*, **20**(10), 1075-1094.

Juran, J M (1951) *Quality Control Handbook*. New York, NY: McGraw-Hill.

Kiani, B, Shirouyehzad, H, Khoshsaligheh, F, Hamidreza, B, Kiani, B, Shirouyehzad, H and Hamidreza, B (2014) System dynamics approach to analyzing the cost factors effects on cost of quality. *International Journal of Quality and Reliability Management*, **26**(7), 685-698.

Krishnan, S K, Agus, A and Husain, N (2000) Cost of quality: The hidden costs. *Total Quality Management*, **11**(4-6), 844-848.

Kumar, K, Shah, R and Fitzroy, P T (1998) A review of quality cost surveys. *Total Quality Management*, **9**(6), 479-486.

Love, P E D and Li, H (2000) Quantifying the causes and costs of rework in construction. *Construction Management and Economics*, **18**(4), 479-490.

Love, P E D, and Irani, Z (2010) A project management quality cost information system for the construction industry. *Information & Management*, **40**(7), 649-661.

Miles, M B and Huberman, A M (1984) *Qualitative Data Analysis: A Source book of New Methods*. London: Sage Publications.

Miguel, P A C and Pontel, S (2003) Assessing quality costs of external failures (Warranty claims). *International Journal of Quality and Reliability Management*, **21**(3), 309-318.

Mukhopadhyay, A R (2004) Estimation of cost of quality in an Indian textile industry for reducing cost of non-conformance. *Total Quality Management and Business Excellence*, **15**(2), 229-234.

Omar, M K and Murgan, S (2014) An improved model for the cost of quality. *International Journal of Quality and Reliability Management*, **31**(4), 395-418.

Özkan, S and Karaibrahimoğlu, Y Z (2012) Activity-based costing approach in the measurement of cost of quality in SMEs: A case study. *Total Quality Management and Business Excellence*, **24**(3-4), 1-12.

Palaneeswaran, E (2006) Reducing rework to enhance project performance. *In*: *Proceedings of the One day Seminar on Recent Developments in Project Management in Hong Kong* (12 May 2006).

Porter, L J and Rayner, P (1992) Quality costing for total quality management. *International Journal of Production Economics*, **27**(1), 69-81.

Roden, S and Dale, B G (2001) Quality costing in a small engineering company: Issues and difficulties. *The TQM Magazine*, **13**, 388-400.

Schiffauerova, A, and Thomson, V (2006) A review of research on cost of quality models and best practices. *International Journal of Quality and Reliability Management*, **23**(3), 647-669.

Snieska, V, Daunoriene, A and Zekeviciene, A (2013) Hidden costs in the evaluation of quality failure costs. *Inzinerine Ekonomika-Engineering Economics*, **24**(3), 176-186.

Srivastava, S K (2008) Towards estimating Cost of Quality in supply chains. *Total Quality Management and Business Excellence*, **19**(3), 193-208.

Tang, S L, Aoieong, R T and Ahmed, S M (2004) The use of Process Cost Model (PCM) for measuring quality costs of construction projects: Model testing. *Construction Management and Economics*, **22**(3), 263-275.

Taggart, M, Koskela, L and Rooke, J (2014) The role of the supply chain in the elimination and reduction of construction rework and defects: An action research approach. *Construction Management and Economics*, **32**(7-8), 1-14.

Tsai, W H (1998) Quality cost measurement under activity-based costing. *International Journal of Quality & Reliability Management*, **15**(7), 719-752.

Tye, L H, Halim, H A and Ramayah, T (2011) An exploratory study on cost of quality implementation in Malaysia: The case of Penang manufacturing firms. *Total Quality Management & Business Excellence*, **22**(February 2015), 1299-1315

Yang, C-C (2008) Improving the definition and quantification of quality costs. *Total Quality Management & Business Excellence*, **19**(3), 175-19.

IMPROVING THE QUALITY MANAGEMENT SYSTEMS FOR ENERGY-EFFICIENT SOCIAL HOUSING PROJECTS

João Alencastro[1], Alba Fuertes and Pieter de Wilde

Environmental Building Group, Plymouth University, Drake Circus, Plymouth, PL4 8AA, UK

Developing and implementing quality management systems (QMS) in construction is particularly difficult because of a lack of standardization, the use of transient workforce and the many parties involved. This paper discusses the challenges faced by social housing providers in the UK when implementing quality assurance programs in their effort to provide their tenants with energy-efficient dwellings. In particular, it focuses on the quality plans defined at the early stages of a project, their impact during the construction process and on the resulting building energy performance. Based on data collected from the project team and documentation, a comparative analysis of the QMS development process of two social housing developments is presented. The key findings show that the two case studies followed different quality management approaches to deliver energy efficient dwellings. The most significant discrepancies were found in defining the energy performance targets and detailing the quality assurance procedures. The contribution of this paper is to create awareness of the importance of defining Quality Assurance Systems with a focus on energy performance from the early stages of a project.

Keywords: building energy performance, defects, quality management

INTRODUCTION

Buildings are acknowledged to play a large role in the current energy use worldwide, being responsible for 40% of primary energy consumption and thus for 40% of the total amount of greenhouse gas emissions (International Energy Agency, 2016). In this regard, the UK government has committed to a legally binding target of reducing carbon emissions by 80% of 1990 levels by 2050 (Her Majesty Government, 2008). In 2014, the domestic sector in the UK accounted for approximately 26.5% of final energy consumption (Department for Energy and Climate Change, 2015a), 66% of this energy was used for space heating (DECC, 2015b). Therefore, to achieve the carbon emission targets it is pivotal to reduce the heating energy use in the sector by upgrading the thermal performance of the existing housing stock and building new energy-efficient dwellings. In line with the objectives undertaken in the Climate Change Act 2008 (HM Government, 2008), the UK social housing sector has engaged in the recent years in a large scale effort in order to reduce carbon emissions, mitigate fuel poverty and increase the comfort level for their tenants (National Energy Foundation, 2016).

[1] joao.ulrichdealencastro@plymouth.ac.uk

Alencastro, J, Fuertes, A and Wilde, P de (2016) Improving the Quality Management Systems for Energy-Efficient Social Housing Projects. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference,* 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 843-852.

However, recent studies indicate that the energy savings intended from the energy efficient retrofits and new-built homes are falling short. The social housing providers recognize themselves lacking a clear understanding of the best practices which would lead them to achieving the energy performance targets (NEF, 2016). This mismatch between the energy performance as predicted at design stage and as measured once the building is in operation is known as the performance gap (Hansford, 2015, Zero Carbon Hub, 2014). Among a wide number of contributing factors to the energy performance gap (De Wilde, 2014), poor quality management and the occurrence of defects have been acknowledged. Defects in buildings' fabric, most of them being hidden defects, lead to undesired air permeability and thermal bridging, and consequently to excessive heat loss (Johnston *et al*., 2015, Bell *et al*., 2005). According to Zero Carbon Hub (2014), the construction industry has already many quality assurance procedures in place, however they prioritise other issues above energy performance. In that sense, there is need for an increased focus on quality throughout the project which ensures the desired energy performance targets.

This paper seeks to investigate (1) how the social housing providers define and implement quality management systems in their new-built and retrofit projects, and (2) identify areas of improvement in these practices towards achieving higher building energy performance. It particularly focuses on how social housing providers consider building energy performance in the initial definition of requirements of the quality management plan, how these requirements are reflected in the procurement stage and finally, how the initial client aspirations are translated into quality assurance procedures when they are deemed ready for implementation in the construction process. Considering the efforts placed by housing associations (HA) to provide energy efficient housing to help their tenants to reduce energy bills and improve comfort levels, this research particularly focuses on the social housing sector.

QUALITY MANAGEMENT IN CONSTRUCTION PROJECTS

The implementation of a quality management system (QMS) in construction organisations has received considerable attention in the last two decades. However, there is a growing body of evidence that shows the existence of repetitive quality issues due to recurrent causes which undermines project goals, including the energy performance (Tofield, 2012). For instance, according to 2015 UK Construction KPI Annual Report (Davis *et al*., 2015) around 31% of the projects completed in 2015 in the UK could not meet their original budgets and 60% had schedule overruns. There are many intertwined reasons which lead projects to unexpected outcomes, being quality defects one of them (Tofield, 2012). The effect of defect occurrences on buildings' energy performance has also been reported in the literature review (Johnston *et al*., 2015).

According to research developed by Carbon Trust (2011) looking at 28 new-build case studies in the UK, the operational energy use was up to five times higher than estimated at the design stage, mainly due to quality issues in the buildings' envelope and services. The benefits of QMS include: higher customer satisfaction, improved programme and budget performances, improved relationships among the involved parties and reduced defect occurrences which might impact in the energy performance of buildings (McIntyre and Kirschenman, 2000, Tofield, 2012). However, research shows that in order to achieve these benefits, a number of operational issues and barriers need to be addressed prior to the implementation of the quality management plan (McIntyre and Kirschenman, 2000).

The primary barrier reported is the nature of the construction industry itself, which involves projects often complex and large, labour intensive and rarely placed in the same location. In addition, there is no constant or standard output as the demand is always fluctuating and projects vary from client to client, are subject to the client's perception of the quality and value and face cut-throat competition (Sommerville, 2007). The multitude of professionals and organisations involved in the project, each of them with their own interests, also pose an important challenge to achieve the aspired quality (Kanji and Wong, 1998). According to Tofield (2012), the many participants often do not share the same background in terms of the necessary technical knowledge and management procedures needed to deliver energy efficient buildings. In that sense, project partnering is a method that can be used to promote cooperation and knowledge sharing between the different parties involved in a project. Kanji and Wong (1998) states that: 'Project partnering is a synergy – a cooperative, collaborative management effort among contracting and related parties to complete a project in the most efficient, cost-effective method possible, by setting common goals, keeping lines of communication open and solving problems together when they arise'. Moreover, Hoonakker *et al*., (2010) state that a successful partnering requires mutual trust among the parties, commitment and discipline. It must be introduced as early as possible in the project in order to allow a proper definition of the project's objectives and strategies, including energy performance targets and QMS focused on energy efficiency of buildings.

Quality is also at risk whenever the design changes are excessive (Hoonakker *et al*., 2010, Gibb and Isack, 2001). Design changes during the construction phase may occur to adapt the construction details to the construction processes or are variations required by the contractor or the client which were not considered in the project inception or design stages, due to lack of integration among the parties. Although, the majority of the projects are one-offs, the different stages and methods deployed in the construction process have several similarities (Karim *et al*., 2005). In that sense, the extensive use of processes and procedures must be welcomed by the project team as a powerful tool to enhance quality and achieve the desired energy efficiency (Gibb and Isack, 2001, Zero Carbon Hub, 2014).

In addition to the significant challenges existing in the design and construction phases, the tendering stage has also been identified as a key process to achieve quality standards. The typical tendering process starts with the release of a project requirements and characteristics for a specific group of contractors or a general public, depending on the procurement route and tendering model. The quantity and quality of the details of a project can vary; nevertheless there must be a minimum amount of information in order to allow the contractors to assess the risks involved and to propose strategies to fulfil the predefined goals (Hoonakker *et al*., 2010) and energy performance objectives. According to Hoonakker *et al*., (2010) and McIntyre and Kirschenman (2000), the low bids and adversarial contracts poses the greatest concerns of implementing quality programmes. To the authors' knowledge, competitive bidding is still a standard practice and can lead contractors to reduce the allotted resources towards safety and quality assurance procedures or to hire cheaper and less skilled subcontractors in order to maximise the profit margin for the contract. Some owners and general contractors, however, are already realizing the benefits of using pre-qualification criteria for selecting and granting contracts (Hoonakker *et al*., 2010). The use of pre-qualification criteria requires the tenderers to meet a pre-set level of performance, experience, safety and implemented quality management system

(Loushine *et al*., 2006). In other words, this approach provides a structured way which allows the owner or general contractor to reduce the risk of working with a poor performing sub-contractor which might compromise the process of delivering energy efficient homes.

METHODOLOGY

The findings presented in this paper are derived from two case studies of a social housing provider located in the South West of the UK. The case study is a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within real life context using multiple sources of evidence with a holistic approach (Yin, 2009). The social HA partaking in the research owns and manages 14,275 homes within one of the major cities in the South West. As part of their commitment to help the social tenants to reduce their energy bills and increase their comfort, as well as tackling carbon emissions, the association is undertaking a major investment to improve the energy performance of the current stock and the new homes. The two case studies are: (1) 72 new affordable dwellings built at Passivhaus standard; and (2) retrofit (external wall insulation) of 38 housing units grouped in 4 building blocks. These two diverse projects were selected seeking to identify similarities and differences on the approaches taken with regards to quality management by the HA in each project, despite having a standard corporate quality management system in place. According to Yin (2009), empirical investigations, in order to avoid biased conclusions, must rely on multiple sources of evidence, with data needing to converge in a triangulating fashion.

For that matter, this research is based on data collected from documents (minutes, contracts, tendering packages, quality programmes, etc.), technical information (plans, detail books, etc.), interviews with the project stakeholders (client, project manager, contractor, architect and consultant) and observations during team management and design meetings. This data has been collected from the early stages of the project and will continue until the completion. This paper, however, presents the initial findings of the stages: 1. Inception, 2. Procurement Strategy, 3. Design Outline and 4. Technical design and Construction preparation. Data is organised following a logical and temporal sequence of the project stages based on a combination of the proposed project management framework from the Office of Government Commerce (2007) and the Royal Institute of British Architects Plan of Work (2013). The analysis of data and the subsequent conclusions are drawn by comparing the case studies' findings against the following theoretical basis: (i) Clearly defined and shared goals and energy performance targets; (ii) Involvement of the parties throughout the process; (iii) Set up of selection criteria (tendering process); (iv) Standardisation; and (v) Set up of quality assurance procedures.

CASE STUDIES

Case Study 1 consists of 72 new affordable dwellings built at Passivhaus standard (Building Research Establishment, 2016). The procurement route is a two-stage Design and Build contract. The client commissioned an independent project manager not only to help with the stages prior to procurement but to work as a facilitator for the whole process. The design team and Passivhaus consultant were novated to the contractor after the procurement stage.

Case Study 2 comprises the retrofit of 38 housing units grouped in 4 building blocks. This project is part of a 20 year retrofit programme, which includes the installation of

external wall insulation, funded entirely by the HA. This programme follows an already applied external wall insulation programme which involved 4,009 units. It is expected that the external wall insulation installations will increase the current SAP ratings (BRE, 2013) of the retrofit homes from 71.6 to 81. A traditional procurement is used for this project. Whilst in the previous case study, a specialist design consultant was employed to achieve the desired energy performance standard, the internal design team of the HA was selected to work on the retrofit scheme as they already had experience accumulated from previous refurbishment works. The asset manager was commissioned to play the role of the project manager. It is worth mentioning that although the two case studies pertain to the same HA, they are coordinated by different managerial branches: Case Study 1, led by the new asset development branch; Case Study 2, led by the asset management branch.

KEY FINDINGS

Case Study 1: 72 new affordable dwellings built at Passivhaus standard

At the project inception stage, the HA's team decided to build the new dwellings at Passivhaus standard. An experienced Passivhaus consultant was employed early in the process to assist not only the already appointed design team but also the independent project manager. The procurement route chosen was design and build. Since the awarded tenderer would be expected to deliver the Passivhaus requirements, it was found important to involve the contractor in early stages of the project and make them responsible for the design process. However, the design team and the specialist consultant were novated to the contractor in the following stages.

The tendering was a two-stage process. The tendering information pack included: a clear set up of performance requirements (e.g. heating demand and airtightness); the Passivhaus accreditation process explained; the performance checks to undertake during the construction process (e.g. airtightness tests); and a list of minimum performance specifications for products and equipment in order to comply with the Passivhaus standards. The invited tenderers were asked to submit their tender, which should include their price for delivering the project along with proposals for how the client's requirements would be satisfied. These proposals should contain the intended strategies to achieve the Passivhaus accreditation, to accomplish the design requirements, to manage the subcontractors and assess their performance and skills, and assure quality and rectify eventual defects.

The design process was supported by the Passivhaus Planning Package, which helped the design team and the main contractor to develop a design proposal that would respond effectively to the defined budget and schedule, as well as comply with the energy performance targets. In this stage several technical solutions were assessed and discussed by the different parties involved in meetings arranged every two weeks. In several occasions bespoken design solutions were adopted. Unfolding the quality assurance strategies proposed at the procurement stage, the main contractor commissioned a dedicated quality surveyor who helped defining and implementing the quality assurance procedures in the next stages of the project. It was also acknowledged that both the quality surveyor and the site manager would benefit from having Passivhaus training, in order to become more acquainted with the requirements and steps of the accreditation process.

During the technical design and construction preparation phase, the quality programme was consolidated prior to the completion of the technical design and detailing. The quality plan was structured in three parts. The first section was

conceived to re-enforce the quality of the technical design, assessing the buildability of the details and the sequencing of the building elements. The second section consisted in identifying the milestones for checking the quality of selected building elements and determining the testing procedures. For instance, it was decided that the pressure tests during the construction process should be performed after the air barrier was installed but prior to the external cladding execution. The third section was aimed at producing the necessary tools to support the quality assurance procedures, such as checking lists and defect record sheets. In order to validate the established quality assurance plan and find areas of improvement, the parties agreed on testing the methods in a set of 5 homes. Therefore, the construction programme was defined so as to allow the construction of 5 dwellings whilst the earthworks and infra-structure execution is being undertaken on-site and before the construction of the rest of the 67 housing units starts.

Case Study 2: External wall insulation in 38 dwellings grouped in 4 building blocks
At the inception stage of the project, the HA asset management team declared their performance aspiration (i.e. increase the current SAP ratings from 71.6 to 81). Despite the HA having such a specific goal, there was no evidence in the project documentation of the specific performance targets (e.g. u-values and air permeability) that the retrofit scheme was aiming to meet. Moreover, the project documentation also lacked of the condition surveys of the dwellings to be retrofitted. A list of practical recommendations was developed by the asset management team based on the previous similar retrofit schemes, such as the retrofit works of the ECO schemes. This recommendation list became the basis for the definition of the technical requirements for both the tendering information packages and design stage.

The procurement approach chosen for the retrofit scheme was the traditional route, where both the design and the project management team pertained to the HA staff and a main contractor is responsible for the construction phase only. The traditional route allowed carrying out the procurement and design outline stages in parallel. However, it limited the amount of involvement of the future contractor in the design process. The tendering information packages, i.e. the invitation to tender documents and contracts, included a pre-defined technical solution for the external wall insulation. The asset management team defined the retrofit solution and its technical characteristics (mostly addressing to thermal bridging) based on previous experiences, where this technology had been deployed in previous works with apparent success and cost effectiveness.

In regard to the quality assurance plan, the HA administered the set of procedures which are standard to similar projects they are undertaking. The pre-selection criteria specified that the tenderers must maintain a recognised "quality assurance system" such as ISO 9001 certification. Apart from that, the HA did not require performance tests or specific checking points to be undertaken during the construction phase, as no performance targets were defined in the early stages of the process. In fact, the HA’s standard quality plan is focused on preventing visual defects which are likely to raise occupants’ complaints but do not specifically concentrate attention in quality defects related to thermal issues. The main contractor is required to provide the HA’s representatives with quality reports once the work for each housing unit is deemed completed. In addition, the contractor must submit all the material invoices to the project manager as a way to prove that the products deployed comply with the design specifications.

During the construction preparation stage, the project manager manifested that additional efforts (on both the design and construction aspects) would be put in place in order to increase the chances of the project to fulfil its aspirational objectives. The measures adopted to improve the design aspects included the appointment of an experienced energy performance consultant to assess the air permeability of the units, undertaking airtightness tests before and after the retrofit in a sample of 20% of the dwellings. Moreover, the consultant assessed the condition of cavity closers and the eaves/wall junctions. As a consequence, the technical detailing produced by the HA's design team was checked and revised. The measures adopted to improve the construction aspects included the appointment of a group of building surveyors working on behalf of the HA in order to check on the quality of the workmanship in parallel to the quality assurance procedures already required to the contractor.

DISCUSSION

Clearly defined and shared goals and energy performance targets

In Case Study 1, since the decision to comply with Passivhaus standards was made, the HA stakeholders acknowledged that external support would be needed throughout the process. Being this the first Passivhaus project in the company, it urged for a different mind-set which allowed the construction of an environment of collaboration and cooperation towards shared goals, as suggested by Hoonakker *et al*., (2010). In line with what was stated by McIntyre and Kirschenman (2000), a multidisciplinary team was hired to work together from the early stages of the project, providing a clear performance targets and strategies which laid the pavement for the procurement stage and the development of the quality assurance plan later in the process. Moreover, the procurement route allowed the contractor to join in the project on time to collaborate from the beginning of the design stage.

Differently in Case Study 2, the asset management branch had a strong background of housing maintenance and refurbishment accumulated in previous works. In fact, the option of using the *traditional* approach in the procurement process was intended to allow the project to fully benefit from the acquired knowledge on similar projects, assuring that the design and project management would be undertaken by the company's staff, and keeping the control of the process within the company. This procurement approach was meant to re-enforce the deployment of standardised technical solution and procedures (Gibb and Isack, 2001), nevertheless it did not take into account the valuable contributions of the awarded contractor as recommended by Kanji and Wong (1998), keeping it apart from the initial stages of the process. Besides, to the authors understanding, the whole process lacked of guidelines of what was expected for the real energy performance. It was assumed that the set performance goals would play this role. As a matter of fact, the aspirational goals of increasing the SAP ratings did not work as proper drivers to the process because they only provided standardised estimates of energy performance and consumption, instead of real performance targets that could be measured during the construction process and in the operational stage; and later on could be compared to the energy performance of the buildings prior to the retrofit works.

Involvement of the parties throughout the process and management commitment

In terms of creating a required environment for the developing management commitment and trust between the different parties, the Case Study 1 adopted a strategy of full involvement of all parties' stakeholders throughout the design development and construction preparation in order to deliver appropriate technical

solution and managerial procedures towards achieving the proposed energy performance goals (Hoonakker *et al*., 2010). Meetings for the development of the design and technical solutions were arranged in every fortnight until the end of the stage 4 – Technical design and construction preparation. The main idea, also shared by Kanji and Wong (1998), was that the options should be discussed and the decisions shared among multidisciplinary project team, always driven by the clear objectives, including energy performance targets, to be achieved. On the other hand, in Case Study 2 the different stages of the process were fragmented not allowing too much room for collaboration or discussion about the best ways to achieve the desired energy efficiency, just as described by Sommerville (2007). For instance, the fact that the project manager requires the contractor to submit the material invoices during the construction stage so he can check whether the purchased products comply with the design specification indicates evidences of mistrust, lack of managerial commitment and shared objectives towards the outcome of the project, already stated by Loushine *et al*., (2006). Another example was the fact that the project manager commissioned an energy specialist consultant to check and revise the design team's detailing regarded the energy efficiency. It would be more adequate to allow the consultant to contribute in a cooperative way in the beginning of the design stage, incentivising teamwork.

Standardisation and set up of quality assurance procedures

Regarding the development of the quality assurance plan, in Case Study 1 the project manager on behalf of the HA made clear from the procurement stage that a bespoken quality assurance procedures would be necessary in order to accomplish the energy performance targets. In fact, the developed plan started to drive the quality process yet in the last stages of the design process and after that setting the testing and checking procedures for the construction stage. In respect to Case Study 2, the inclination to use standardised set of procedures based on previous experiences proved to provide consistent contributions in terms of the expertise accumulated (Karim *et al*., 2005). Nevertheless, in respect to the issues related to the energy performance, the standard quality assurance plan would not add much value because it was not designed to this purpose. Even though the additional effort put in place in order make the detailing more robust seems to be mistimed and uncoordinated, it will definitely contribute to increase the buildings' operational energy performance. Moreover, the group of building surveyors commissioned to check the quality during the construction stage would be more effective if the quality assurance plan would have been reviewed, setting structured checking procedures and milestones for inspections and not only relying solely on the accumulated knowledge, as suggested by Tofield (2012).

CONCLUSIONS

To the authors understanding, it is undeniable that the parties involved in both case studies acknowledged that pursuing quality during the construction process is paramount to achieve the desired energy performance targets. However, the cases undertaken in this research differ in how to set out the proper strategies which allow the development of an effective quality assurance plan. The first key factor in order to produce a quality assurance plan which encompasses measures that help achieving the desired energy performance is to have a robust understanding of the performance targets to be defined. It is also crucial to understand the issues which might undermine the achievement of the targets in terms of faulty design and detailing, as well as quality defects that may occur in the construction stage. In that matter, having experienced professionals among the parties involved from the beginning of the

project is vital. Moreover, the performance targets must be measurable, ideally during the construction process, so any necessary corrections can be applied early enough and when the remediation costs are less expensive than the operational stage. In regard to retrofit schemes, a full assessment of the building condition is fundamental to understand the challenges that might be encountered ahead and select the most suitable strategies.

The second key factor is choosing the proper procurement route which would suit the project's characteristics and aspirations. The procurement approach should allow the different parties to get involved early in the process in order to develop a shared decision-making environment and thus, generate commitment between the parties. In terms of the procurement information packages, it must provide the tenderers with sufficient information on the desired performance targets and how the tests and evidences of the performance levels are to be provided. Additionally, the awarded contractor should be legally bound to fulfil the performance targets through the contract documentation. The contractual clauses should have to go hand in hand with a measurement mechanism which must be supported by the quality assurance procedures to be implemented during the construction phase.

The overall idea is that the process of developing a quality assurance plan must start with a clear definition of the performance targets in the early stages of the process. The second step is to identify the adequate strategies which would guarantee that the targets will permeate the following stages from the procurement to the design and construction preparation phase, culminating in the completion of the quality plan. The strategies to be implemented should be able to translate properly the performance goals into objective and accountable measures. These measures, in turn, will stablish responsibilities, milestones for checking and testing and adequate ways to report the performance of the building elements surveyed. Nevertheless, a robust quality programme is not made only of a set of procedures and tools; to be effective it requires an environment of trust, collaboration and team working.

ACKNOWLEDGEMENTS

The research reported in this paper is being undertaken as part of a PhD research project at Plymouth University. The project is funded by the Brazilian Ministry of Science, Technology and Innovation through the Science without Borders research program (Project reference: 203105/2014-1).

REFERENCES

Bell, M, Smith, M and Miles-Shenton, D (2005) *Condensation Risk: Impact of Improvements to Part L And Robust Details On Part C, Interim Report Number 7: Final Report on Project Fieldwork*. Leeds Metropolitan University: Leeds.

Building Research Establishment (2013) *The Government's Standard Assessment Procedure for Energy Rating of Dwellings*. Watford: DECC/Building Research Establishment.

Building Research Establishment (2016) *The Passivhaus Standard.* Available at http://www.bre.co.uk/page.jsp?id=2856 [Accessed 04/04/2016 2016].

Carbon Trust (2011) *Closing the Gap: Lessons Learned on Realising the Potential of Low Carbon Building Design*. London: Carbon Trust.

Davis, R, Wilen, A, Crane, T, Bryer, L, Ward, D, Pottier, F, Cavin, L, Blofeld, S and Blackwell, M (2015) *UK Industry Performance Report 2015: Construction Industry KPIs.* Glenigan, CITB, and Department for Business Innovation & Skills.

DECC (2015a) *Digest of United Kingdom Energy Statistics 2015*. London: Department for Energy and Climate Change.

DECC (2015b) *Energy Consumption in the UK: Overall Data Tables 2015 Update.* London: Department for Energy and Climate Change.

De Wilde, P (2014) The gap between predicted and measured energy performance of buildings: A framework for investigation. *Automation in Construction*, 41, 40-49.

Gibb, A G F and Isack, F (2001) Client drivers for construction projects: implications for standardization. *Engineering Construction and Architectural Management*, **8**(1)**,** 46-58.

HM Government (2008) *Climate Change Act 2008: Elizabeth II*. London.

Hansford, P (2015) *Solid Wall Insulation: Unlocking Demand and Driving Up Standards*. Green Construction Board and HM Government.

Hoonakker, P, Carayon, P and Loushine, T (2010) Barriers and benefits of quality management in the construction industry: An empirical study. *Total Quality Management & Business Excellence*, **21**(9)**,** 953-969.

International Energy Agency (2016) FAQs: Energy Efficiency. Available at ⟨http://www.iea.org/aboutus/faqs/energyefficiency/⟩ International Energy Agency [Accessed 21/03/2016 2016].

Johnston, D, Miles-Shenton, D and Farmer, D 2015 Quantifying the domestic building fabric 'performance gap' *Building Services Engineering Research and Technology*.

Kanji, G K and Wong, A (1998) Quality culture in the construction industry. *Total Quality Management*, **9**(4-5)**,** 133-140.

Karim, K, Marosszeky, M and Kumaraswamy, M (2005) Organizational effectiveness model for quality management systems in the Australian construction industry. *Total Quality Management & Business Excellence*, **16**(6)**,** 793-806.

Loushine, T W, Hoonakker, P L T, Carayon, P and Smith, M J (2006) Quality and safety management in construction. *Total Quality Management & Business Excellence*, 17(9), 1171-1212.

McIntyre, C and Kirschenman, M (2000) Survey of TQM in construction industry in upper Midwest. *Journal of Management in Engineering*, **16**(5)**,** 67-70.

National Energy Foundation (2016) *Insights from Social Housing Projects: Building Performance Evaluation Meta-Analysis* Executive Report Innovate UK, National Energy Foundation.

Office of Government Commerce (2007) *Achieving Excellence: Construction Projects Pocketbook* London: Office of Government Commerce, HM Treasury.

RIBA (2013) *Plan of Work 2013* Available at http://www.ribaplanofwork.com/Download.aspx.

Sommerville, J (2007) Defects and rework in new build: an analysis of the phenomenon and drivers *Structural Survey*, **25**(5)**,** 391-407.

Tofield, B (2012) *Delivering a Low-Energy Building: Making Quality Common Place* (Build with CaRe report) Adapt Low Carbon Group, University of East Anglia, Norwich.

Yin, R (2009) *Case Study Research: Design and Methods* Los Angeles: Sage Publications.

Zero Carbon Hub (2014) *Closing the Gap between Design and as-Built Performance: End Of Term Report* London: Zero Carbon Hub.

A PROBLEM SOLVING APPROACH TO IDENTIFYING CIVIL ENGINEERING INFRASTRUCTURE PROJECTS

Mohamed H Elmahroug[1,2], Apollo Tutesigensi[1] and Nigel J Smith[1]

[1] *Institute for Resilient Infrastructure, School of Civil Engineering, University of Leeds, Woodhouse Lane, Leeds, LS2 9JT, UK*

[2] *Department of Civil Engineering, Faculty of Engineering, University of Eljabel Elgharbi, Gherian, Libya*

Civil engineering infrastructure projects are solutions to problems facing communities, societies or even an entire nation. Addressing societal needs and problems is a key element of infrastructure project success. However, recent evidence suggests that decision makers often invest in projects that do not address clearly defined problems. Therefore, this research aims to contribute towards improving the identification process of civil engineering infrastructure projects. A desk study involving mapping of a generic infrastructure project life cycle onto two problem solving process models was undertaken. It was found that if civil engineering infrastructure projects are viewed as solutions to problems, ideas of a problem solving process can be adapted and incorporated into the identification process of infrastructure projects. This led to the design of a novel two-stage identification process for civil engineering infrastructure projects. The process brings together developers and concerned stakeholders to: first agree on the problem to be addressed, and second generate solutions, assess them and then choose a preferred solution to be implemented. Identifying civil engineering infrastructure projects in this manner ensures that public funds are spent on projects that address societal problems, provide the greatest benefits to society, and that they are spent in the most efficient way.

Keywords: civil engineering infrastructure, project identification, problem solving

INTRODUCTION

Civil engineering infrastructure projects, such as highways, bridges, airports and railways, form the backbone of any modern, successful and competitive economy (HM Treasury 2013). They promote prosperity and growth, improve quality of life and enhance the well-being of a modern society. The adequacy of infrastructure helps determine one country's success and another's failure. Good infrastructure raises productivity and lowers production costs, but has to expand fast enough to accommodate growth (World Bank 1994). Well-developed infrastructure is a critical factor for ensuring the effective functioning of the economy, as it determines the location of economic activities that can develop within a country, and integrates the national market as well as connecting it to markets in other countries and regions (World Economic Forum 2013). Therefore, client organisations for civil engineering infrastructure projects (often governments/public sector organisations) seek to ensure

[1] cnmhe@leeds.ac.uk

Elmahroug, M H, Tutesigensi, A and Smith, N J (2016) A Problem Solving Approach to Identifying Civil Engineering Infrastructure Projects. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference,* 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 853-862.

they invest in the right project at the right time in order to secure economic competitiveness in the long term (Gardiner 2005).

Although infrastructure developers strive to invest in the right infrastructure, evidence from McKinsey Global Institute (Dobbs *et al*., 2013) suggests that decision makers often invest in projects that do not address clearly defined problems and improving project identification process could save $200 billion a year globally (ibid). The present paper is therefore important because it contributes towards improving the identification process of civil engineering infrastructure projects, and hence contributes to achieving this global annual savings. To begin, the importance of accurate project identification is discussed, and evidence for inaccurate project identification is presented. After this, the research problem and the approach to address it are outlined. Findings are then highlighted and discussed.

PROJECT IDENTIFICATION

Project identification is the process of identifying projects. The identification phase, according to Corrie (1991), comprises the preliminary appraisal of a potential project, and aims to decide whether a feasibility study should be undertaken. The outcomes of the identification phase include a list of options to be considered and the ground rules for the feasibility stage. The authors observe that the identification phase is often embedded in the concept phase, for example, Turner (2007), Association for Project Management (2006), British Standards Institution (2000), Abdul-Kadir and Price (1995) and Adams and Barndt (1988). The concept phase is the first phase in the project life cycle during which the need, opportunity or problem is confirmed, the overall feasibility of the project is considered and a preferred solution identified (Association for Project Management 2006). The tasks that must be accomplished during this phase often include: identifying need, establishing feasibility, identifying alternatives, preparing proposal, developing basic budget and schedule and identifying project team (Adams and Barndt 1988).

In addition, project identification appears to be insufficiently established in the internationally recognised project management standards and methods. For instance, the BS 6079 assumes that a project brief is prepared to trigger the project. It supposes that a preparatory work to prepare a project brief is carried out before the formal start of the project (British Standards Institution 2010). However, BS 6079 does not offer much advice on the process through which the project brief is produced. Moreover, PRINCE2 assumes a project mandate exists to trigger the project (Office of Government Commerce 2009). Although the project mandate is a “product”, PRINCE2 gives little information on the process through which this product is produced. Furthermore, The Royal Institute of British Architects (RIBA) Plan of Work assumes that the project is strategically appraised and defined before a detailed brief is created (Royal Institute of British Architects 2013). However, the Plan of Work offers no advice on the process through which the client’s strategic definition is produced. Here, the authors acknowledge the major strength of these project management standards and methods, and understand that they are project orientated. However, focus on these standards and methods has dominated project management practice and attention has to be given to the documents that trigger a project. The present paper is a step in this direction.

Although project identification is often not recognised as a discrete phase, previous research on critical success factors (CSFs) for infrastructure projects have indicated the importance of the project identification process. In fact, appropriate project

identification is a critical factor for the success of Build–Operate–Transfer (BOT) projects, as it enhances the possibility of good outcome in the preliminary evaluation phase of a BOT project (Qiao *et al*., 2001). Tiong (1996), who studied the CSFs in winning BOT concessions, states that one of the crucial factors in winning a BOT contract is to identify and choose the right project to initiate. Building on documented experiences and lessons learned from successful BOT projects, interviews of BOT project promoters and government officials and their consultants and questionnaire surveys, Tiong's findings show that the ability to predict accurately the need for the project is the most critical task when identifying projects (ibid). Another research study into improving the delivery of social development objectives by modifying the way in which infrastructure projects are procured (Hawkins *et al*., 2006) concludes that the biggest potential social impact probably lies in the choice of the project, and the decisions taken in the early stages of a project (during the project identification phase) have the greatest impact on the achievement of social development objectives.

The foregoing paragraphs suggest that particular attention needs to be given to the important identification process of infrastructure needs/projects. This is particularly vital to the UK government, because ninety-five per cent of government policies is delivered through major infrastructure projects (National Audit Office 2013a). Therefore, accurate identification of infrastructure needs is essential to the government delivering its promises and objectives. This is supported by the fact that inaccurate identification of the need for infrastructure topped the UK's National Audit Office's list of key risks to value for money (National Audit Office 2013b).

The problem being addressed here is that although the importance of accurate identification of infrastructure needs is recognised, evidence from McKinsey Global Institute (Dobbs *et al*., 2013) suggests that decision makers often invest in projects that do not address clearly defined problems. Another evidence from the UK (National Audit Office 2013a) suggests that the UK government often commits to a 'solution' without fully understanding the context and exploring alternative options to determine which solution matches the real problem. According to Dobbs *et al*., (2013) this is because decision makers often default to investments in additional physical capacity without sufficiently focusing on the underlying needs and finding the most effective solutions to address that need.

The authors acknowledge that new civil engineering infrastructure projects are often the means for governments to deliver their policies and thus achieve political gains. This makes these projects political. However, it should be indicated that the present paper does not intend to explain why investment often flows into politically preferred projects. In the authors' view, the evidence presented above suggests that there is a need for an overarching identification process that allows the start point of every infrastructure initiative to be problem identification. Therefore, the aim of the paper is to contribute to the improvement of the identification process of civil engineering infrastructure projects in the UK, so that investment flows into projects that address societal problems. The following section explains the method used to achieve this aim.

METHOD

A desk study involving a review of two problem solving process models, and a comparison of the steps in these models with the project phases in a generic civil engineering infrastructure project life cycle was undertaken. The purpose was to show that if civil engineering infrastructure projects are viewed as solutions to

problems, the project life cycle can be mapped onto a problem solving process. Ideas in these models were then adapted and incorporated into the identification process of civil engineering infrastructure projects.

The generic project life cycle used in the present paper was derived from comparing and contrasting several project life cycle methodologies (Institution of Civil Engineers 2009; Association for Project Management 2006; Young 2006; Chapman and Ward 2003; Abdul-Kadir and Price 1995; Adams and Barndt 1988). It comprises five generic phases: identification; planning; construction; operation and termination. The two problem solving models on which the generic project life cycle was plotted are best discussed in Proctor (2010) and Bransford and Stein (1993), though the following paragraphs outline the steps followed in each model and explain them briefly.

Bransford and Stein (1993) proposed a model for problem solving in which components are represented by the acronym IDEAL, where:

I = Identify problems;

D = Define goals;

E = Exploring possible options;

A = Anticipate and Act; and

L = Look and Learn.

According to Bransford and Stein (1993), problem identification is one of the most important steps in the problem solving process. Bransford and Stein argue that it is just as important to actively look for potential problems as simply to respond to them when they become critical or noticed (ibid). Defining goals often reflects how different people perceive the same problem. Therefore, defining the goals is a crucial step in moving towards a solution. Moving straight to the exploration of possible options without considering alternative goals often leads to difficulties in deciding which option to choose. Moreover, if goals have not been specified, generated options may not provide acceptable answers to a given problem. Exploring possible options involves reanalysing goals and considering alternatives that might be implemented to achieve those goals. Following the selection of an option, contingency plans should be made and the chosen option implemented. The last component of the IDEAL model is to look back at the effects of the implemented option and learn from the experience.

Proctor (2010) proposed a creative problem solving process based on the IDEAL model consisting of six stages as follows: define the problem area; gather information; define the problem correctly; generate solutions to the problem; evaluate and choose between possible solutions; and implement chosen idea correctly. According to Proctor, each stage involves activities that require first divergent thinking and then convergent thinking (ibid). In divergent thinking the task is to generate as many ideas and solutions as possible. Once an exhaustive number of ideas have been reached, convergent thinking takes place. The aim of this thinking is to focus on obtaining solutions to the problem based on the ideas from the divergent thinking.

In support of our argument, we have plotted the generic project life cycle to the two problem solving models, as illustrated in Figure 1. The purpose of this diagram is to show that if civil engineering infrastructure projects are viewed as solutions to problems, the project life cycle can be mapped onto problem solving process. Interestingly, the first three steps of the IDEAL model and the first five steps of

Proctor's model map on the project identification phase. Therefore, we adapt ideas in these steps and then incorporate them into the identification process of civil engineering infrastructure projects. The findings resulted from implementing this method are outlined and discussed in greater details in the subsequent section.

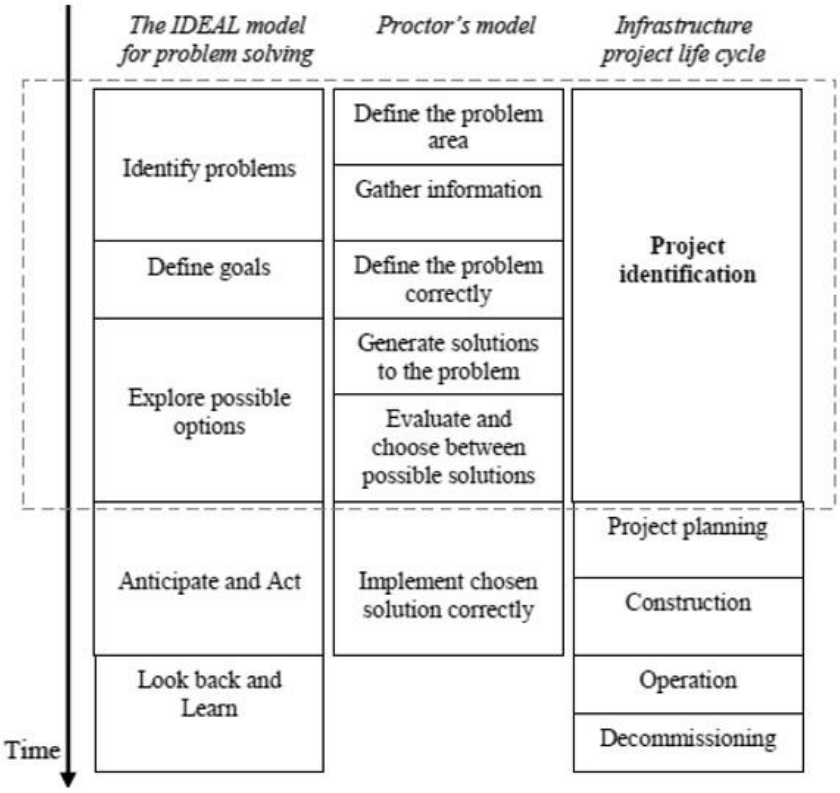


Figure 1 Civil engineering infrastructure project life cycle vs. problem solving process

FINDINGS AND DISCUSSION

Implementing the method explained in the foregoing section resulted in a two-stage identification process for civil engineering infrastructure projects, Figure 2. The proposed identification process allows civil engineering infrastructure projects to begin with problem identification. It brings together infrastructure developers and concerned stakeholders at a sufficiently early stage to: first agree upon the problem(s) to be addressed, and second to generate solutions, assess them and then agree on a preferred solution to be implemented.

The two-stage identification process involves activities that require first divergent thinking and then convergent thinking. Divergent thinking is the thinking that moves away in diverging directions so as to involve a variety of aspects and which sometimes lead to novel ideas and solutions. In contrast, convergent thinking is the thinking that brings together information focussed on solving a problem. In the divergent thinking, the task is to generate as many ideas as possible. There should be no limits to the ideas formed during this thinking. Once a satisfactory level of ideas has been reached, convergent thinking must be used. The purpose of the convergent thinking is to focus on obtaining solutions to the problem based on the ideas from the divergent thinking. The following sub-sections discuss the components of the proposed two-stage identification process in more details.

Stage 1: Agree on a problem

The product of Stage 1 is a well-defined, agreed upon problem. This stage involves five steps as discussed below.

Identify affected stakeholders
During this step infrastructure developers need to effectively identify all concerned stakeholders using a variety of stakeholder identification techniques. Stakeholder identification should be carried out constantly throughout the process. This is important because according to Warner (1984), problems and their corresponding solutions can be defined only within the context of the communities in which they exist. Therefore, it is crucial to identify the communities and the people who live in them before any attempts at generating solutions are made.

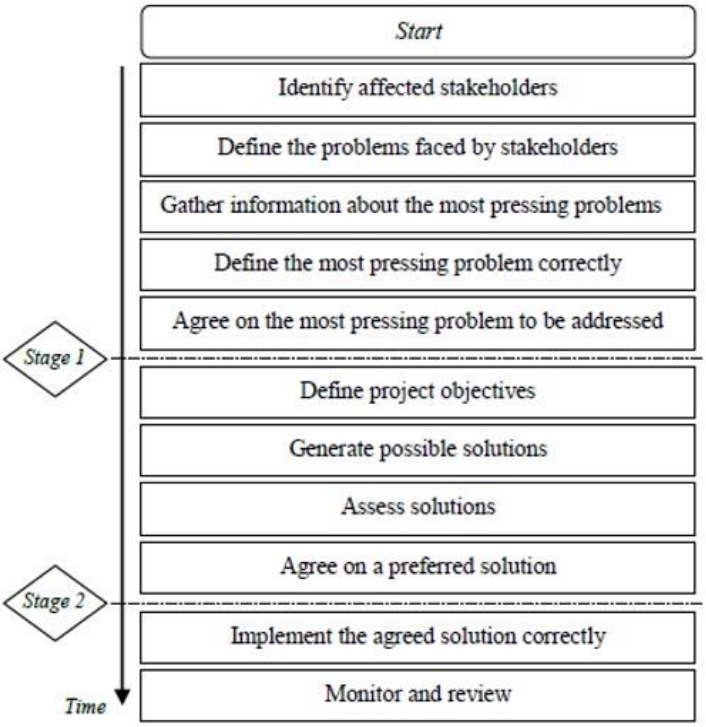


Figure 2 Proposed two-stage identification process for civil engineering infrastructure projects

Define the problems faced by stakeholders
Establishing and defining the problem to be addressed is probably the most important step in Stage 1 of the two-stage identification process, for unless the problem is already correctly defined it is unlikely that an effective solution can be found. Defining the problems involves divergent thinking to generate a list of problems encountered by the stakeholders. These problems are then assessed to a level that enables developers and stakeholders to prioritise them. Thus, ownership, priority and urgency of the problems should also be identified at this stage. Once the problems have been assessed, the most pressing problem can be identified and the next step (gather information about the most pressing problem) begins.

Gather information about the most pressing problem
This step can be considered as a fact finding mission. Developers and concerned stakeholders collect relevant information about the most pressing problem in order to increase the overall comprehension of the problem. As a result, new ideas will be

generated and the previously identified problem may now be seen from a new perspective. This requires the move to the next step of the process in order to define the most pressing problem correctly.

Define the most pressing problem correctly
This step considers a variety of problem perspectives. At this stage, developers and concerned stakeholders examine the information obtained during the previous step to generate possible problem redefinitions. Here, it should be indicated that since different stakeholders may have different perspectives of the most pressing problem, and hence different views to its precise nature, there is a need to consult all concerned stakeholder before the most pressing problem is finally fully specified. The objective of this step is a precise definition of the most pressing problem.

Agree on the most pressing problem to be solved
It is likely that the number of stakeholders in a civil engineering infrastructure project can be large, and involving all of them in agreeing on the problem to be solved can be challenging. Therefore, we introduce this stage gate – agree on the problem. Once the most pressing problem has been precisely defined and communicated to all concerned stakeholders, consensus must be sought. In order to facilitate this, infrastructure developers will need to work closely and collaboratively with concerned stakeholders in a spirit of openness and transparency throughout the whole process. Although specifying a consensus building mechanism is outside the scope of this paper, voting can be considered whenever a consensus on the problem cannot be built. However, it should be stated that what is more important than building toward a consensus on a problem is defining the problem correctly. Once the most pressing problem to be addressed has been precisely defined and agreed upon by stakeholders, Stage 2 of the two-stage identification process begins.

Stage 2: Agree on a solution

The product of Stage 2 is a workable, agreed upon solution. This stage involves four steps as described below.

Define project objectives
The first task to be carried out (once the most pressing problem has been well-defined and agreed upon) is to carefully define the project objectives in the problem situation. Defining objectives is a crucial step in moving towards a solution to a problem because if objectives have not been specified, solutions generated may not provide acceptable answers to the problem. Here, the authors recommend that alternative objectives should also be considered before moving to the exploration of possible solutions, because solutions may well be generated which solve a given problem, but deciding which solution to choose then becomes a difficult problem.

Generate possible solutions
This involves ideas finding to help structure the search for potential solutions. This step uses mainly divergent activity to generate many ideas using a variety of idea-generation aids. The aim is to explore alternative approaches to solving the problem. It should be noted that this may involve reanalysing the objectives (defined during the previous step) and considering options that might be employed to achieve those objectives. Once a number of possible solutions/options have been identified, the developers and concerned stakeholders are ready to move to the next step.

Assess and choose between possible solutions
In this step developers and concerned stakeholders choose the idea that can be transformed into a workable solution. It should be noted that the process of choosing a solution is likely to have a set of alternatives and also a set of assessment criteria. Therefore, assessing a list of alternative solutions involves measuring, trading-off or even scoring alternatives in terms of the assessment specified criteria.

Agree on a preferred solution
Once all possible, viable solutions have been assessed by the developers and concerned stakeholders, a preferred solution can be chosen and agreed upon. Communication with concerned stakeholders is significantly important in reaching agreement on the preferred solution. This requires developers and concerned stakeholders to work closely and collaboratively in a spirit of openness and transparency. It should be indicated that although specifying a consensus building mechanism is outside the scope of this research, voting can be considered whenever a consensus on a solution cannot be built.

In the two-stage identification process, infrastructure developers would work closely and collaboratively in a spirit of openness and transparency with other concerned stakeholders who have relevant knowledge and a stake in the infrastructure need/issue that is being tackled. This would enhance the understanding of the needs/problems where various stakeholders with different knowledge, stakes and values are involved. Bringing together infrastructure developers and concerned stakeholders to work cooperatively would also increase the likelihood that the nature of the problem can be better understood. Moreover, collaboration, openness and transparency increase the likelihood that solutions to problems faced by stakeholders can be found and agreed upon, because greater cooperation improves the prospect that diverse stakeholders may reach an understanding about what actions to take to address the problem.

Moreover, the divergent thinking involved in the process when identifying problems and generating ideas/solutions allows greater room to discover alternative means of solving problems. Thus, any problem to be addressed will be a legitimate problem, and any chosen solution to address it will be the most appropriate and will not become subject to controversy at later stages of the project life cycle. In addition, using a problem solving process as a means of developing and delivering civil engineering infrastructure projects paves the way for the start point of every infrastructure initiative to be a problem identification.

The authors acknowledge that some problems may not be definitively described. These problems have been called “wicked problems” – those that are complex, unpredictable, ill-formulated or intractable, and any proposed solution to address them often turns out to be worse than the symptoms (Rittel and Webber 1973; Churchman 1967). However, the proposed two-stage identification process helps facilitate a more understanding of the seriousness of these problems and puts forward possible responses to them through collaborative working, divergent and convergent thinking, openness and transparency. These strategies for dealing with wicked problems have been proposed by (Head and Alford 2015).

The establishment of the National Infrastructure Commission (NIC) by the UK government shows that there is an emerging direction of travel consistent with the ideas in the present paper in the UK. NIC is expected to provide expert, independent advice on pressing infrastructure issues, produce an in-depth assessment of the UK’s major infrastructure needs and give advice on how to meet them (HM Treasury 2015).

Although recommendations made by NIC will be based on robust analysis and evidence, and will subject to Parliamentary scrutiny, it is the government who will have the upper hand over what infrastructure projects to be built. This suggests that the introduction of NIC changes structure and actors, but not practice. Therefore, the potential for NIC to improve the process of identifying and delivering infrastructure needs will be low, and the present paper can be considered as a step for improvement.

CONCLUSIONS

The purpose of this paper was to contribute towards improving the identification process of civil engineering infrastructure projects, so that these projects are identified to address societal problems. This aim was achieved by adapting problem solving ideas and incorporating them into the identification process of civil engineering infrastructure projects. The research findings reveal that if civil engineering infrastructure projects are accepted to be solutions to problems, they can be identified through a problem solving process. One of the more significant findings to emerge from this paper is the proposed two-stage identification process. The process brings together infrastructure developers and concerned stakeholders at the earliest stage of the project life cycle to: first agree on the problem to be addressed, generate worthwhile solutions and assess them for consensus or near consensus project that can be implemented with minimal disruption and conflicts. Developing and delivering civil engineering infrastructure projects in this manner ensures that public funds are spent on projects that address clearly legitimate problems, provide the greatest benefits to society, and that they are spent in the most efficient way.

An in-depth evaluation of the proposed two-stage identification process lies outside the scope of this paper. Future studies will consider the benefits of the proposed process and work is currently on-going in this area. The research reported here was conducted in the UK, so its findings may have reflected the UK environment.

REFERENCES

Abdul-Kadir, M R and Price, A D F (1995) Conceptual phase of construction projects. *International Journal of Project Management*, **13**(6), 387-393.

Adams, J R and Barndt, S E (1988) Behavioral implications of the project life cycle. *In*: D I Cleland and W R King (Eds.) *Project Management Handbook 2nd Edition*. USA: John Wiley and Sons, Inc.

Association for Project Management (2006) *APM Body of Knowledge 5th Edition*. UK: APM.

Bransford, J D and Stein, B S (1993) *The Ideal Problem Solver: A Guide For Improving Thinking, Learning, and Creativity 2nd Edition*. New York: W H Freeman.

British Standards Institution (2000) *BS 6079-2: 2000. Project Management - Part 2: vocabulary*. London: BSI.

British Standards Institution (2010) *BS 6079-1: 2010. Project management - Part 1: Principles and guidelines for the management of projects*. London: BSI.

Chapman, C B and Ward, S (2003) *Project Risk Management: Processes, Techniques and Insights 2nd Edition*. Chichester: John-Wiley and Sons.

Churchman, C W (1967) Free for all. *Management Science*, **14**(4), B-141-B-146.

Corrie, R K (1991) *Project evaluation*. London: Telford.

Dobbs, R, Pohl, H, Lin, D, Mischke, J, Garemo, N, Hexter, J, Matzinger, S, Palter, R and Nanavatty, R (2013) *Infrastructure Productivity: How To Save $1 Trillion A Year*. McKinsey Global Institute. [Accessed 08 November 2015]. Available from: http://goo.gl/LI7Y7U.

Gardiner, P D (2005) *Project Management: A Strategic Planning Approach*. New York: Palgrave Macmillan.

Hawkins, J, Herd, C and Wells, J (2006) *Modifying Infrastructure Procurement to Enhance Social Development*. UK: Institution of Civil Engineers and Engineers against Poverty. Available from: http://goo.gl/rZ07aW.

Head, B W and Alford, J (2015) Wicked problems: Implications for public policy and management. *Administration* and *Society*, **47**(6), 711-739.

HM Treasury (2013) *National Infrastructure Plan: 2013*. London: Crown. [Accessed 20 January 2014]. Available from: http://goo.gl/Espq4R.

HM Treasury (2015) *Infrastructure at heart of spending review as chancellor launches national infrastructure commission*. London: Crown. 30 October 2015. Available from: https://goo.gl/g8lrgT.

Institution of Civil Engineers (2009) *Client Best Practice Guide*. UK: Thomas Telford Limited. Available from: http://goo.gl/SjsFFi.

Qiao, L, Wang, S Q, Tiong, R L K and Chan T S (2001) Framework for critical success factors of BOT projects in China. *Journal of Structured Finance*, **1**(1), 53-61.

National Audit Office (2013a) *Over-Optimism in Government Projects: Report*. UK: NAO. [Accessed 14 January 2014]. Available from: http://goo.gl/FTPXJD.

National Audit Office (2013b) *Planning For Economic Infrastructure*. London: The Stationery Office. [Accessed 12 September 2014]. Available from: http://goo.gl/vPIB9s.

Office of Government Commerce (2009) *Managing Successful Projects with PRINCE2 5th Edition*. London: TSO.

Proctor, T (2010) *Creative Problem Solving For Managers: Developing Skills for Decision Making and Innovation 3rd Edition*. London: Routledge.

Rittel, H W J and Webber, M M (1973) Dilemmas in a general theory of planning. *Policy Sciences*, **4**(2), 155-169.

Royal Institute of British Architects (2013) *RIBA Plan of Work 2013: Overview*. London: RIBA. [Accessed 29 January 2014]. Available from: http://goo.gl/qRUR5e.

Tiong, R (1996) CSFs in competitive tendering and negotiation model for BOT projects. *Journal of Construction Engineering and Management*, **122**(3), 205-211.

Turner, J R (2007) Projects and their management. *In*: J R Turner (Ed.) *Gower Handbook of Project Management 4th Edition.* England: Gower Publishing Ltd.

Warner, D B (1984) Rural water-supply and sanitation planning: The use of socioeconomic preconditions in project identification. *Journal of Hydrology*, **68**(1), 443-459.

World Bank (1994) *World Development Report 1994: Infrastructure For Development*. Oxford: Oxford University Press. Available from: http://goo.gl/7v0asY.

World Economic Forum (2013) *The Global Competitiveness Report 2013-2014*. Geneva, Switzerland: World Economic Forum. [Accessed 24 March 2015]. Available from: http://goo.gl/E3rtAj.

Young, T L (2006) *Successful Project Management 2nd Edition*. London: Kogan Page.

THE APPLICATION OF STAKEHOLDER THEORY TO UK PPP STAKEHOLDERS

Andrew McErlane[1], George Heaney, Martin Haran and Sharon McClements

Faculty of Art & Design and the Built Environment, University of Ulster, Shore Road, Newtownabbey, County Antrim, BT37 0QB, UK

Recruiting the constructs of legitimacy, power and interest, together with a social network analysis approach, this research identifies the key stakeholders in Public-Private Partnerships (PPP) infrastructure projects and delineates their involvement in United Kingdom (UK) infrastructure provision. PPP is a provision mechanism capable of delivering more and better infrastructure, nevertheless, it continues to be associated with problems. Defined as a collaboration between the public and private sectors, there is consensus that inherent relationships are a primary source of poor project performance. Literature shows that successful partnerships nurture stakeholder collaboration, yet an absence of defined systems and mechanisms to identify stakeholders has manifested in little agreement as to who ought to be involved in these arrangements. This research fills this knowledge gap. Through the application of Stakeholder Theory, this research determines and profiles the key stakeholders in PPP infrastructure projects. Contingent on their contractual relationship, the findings of this investigation ascertain the key stakeholders to be the private sector Special Purpose Vehicle (SPV) and its constituent members; financiers, construction contractors, facilities management contractors, and the public sector Authority. From an examination of these stakeholders and the PPP 'environment', two relationship dynamics are identified. These relationships transition at financial close, at construction completion and at refinancing. This research adds to knowledge by not only contributing a framework to identify and understand PPP stakeholders, but also by imparting the fundamentals of these key stakeholders, enhancing their understanding, thereby providing the foundations on which to construct improved partnering arrangements.

Keywords: public-private partnerships, infrastructure provision, stakeholder identification

INTRODUCTION

Attributable to its fundamental role in socioeconomic development, internationally, future infrastructure provision is being prioritised and estimated to equate to almost $80 trillion between 2014 and 2030 (Inderst and Stewart, 2014). Equally, in the UK, there are pertinent signposts indicating a necessity to counter historical under-investment and upgrade much needed services and facilities (NAO, 2015). A failure to keep investment pace with other nations has meant that UK infrastructure now ranks 24th internationally and has subsequently fallen behind many of its competitors (WEF, 2016). HM Treasury (2011) states "Britain will not be able to compete in the modern world unless we improve our infrastructure". To alleviate these deficiencies, under the auspices of the UK government, public and private sector funding will be

[1] mcerlane-a@email.ulster.ac.uk

McErlane, A, Heaney, G, Haran, M and McClements, S (2016) The Application of Stakeholder Theory to UK PPP Stakeholders. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 863-872.

channelled into both economic and social infrastructure through strategised schemes including the National Infrastructure Plan (NIP) and the Priority School Building Programme (PSBP). A model earmarked to play a role in this recovery is Public-Private Partnerships (PPP).

PPP are regarded as being situated somewhere between traditional procurement and full privatisation and are characterised by a whole life-cycle approach. Both public and private sectors are involved not only in the asset construction but also during the operations of the service (Raganelli and Fidone, 2007). The private sector, over a range of contractual mechanisms and performance regimes is typically responsible for design, construction, financing, management and operations of a service. A revenue is accordingly paid to the private sector for the services provided. PPP can thus be defined as a fixed 25 to 35 year arrangement between the public and private sectors; sharing risks, resources and rewards, to deliver infrastructure projects whereby financing comes from the private sector for the provision of public sector services.

In the UK, PPP, and in particular the Private Finance Initiative (PFI) have been previously operationalised across 722 projects with a total capital value of £57.7 billion for the provision of schools, hospitals, roads and prisons (HM Treasury, 2016). Nevertheless, despite having accounted for some 10-14% of capital budgets annually, in more recent years, appetite for this procurement model has lessened. UK PPP models repeatedly have been associated with problems. Conflicting objectives, undefined roles and responsibilities, as well as an absence of trust, are just some factors which have detracted from partnering arrangements. Subsequently, literature signposts stakeholder relationships are a primary source of poor project performance (Roehrich *et al*., 2014).

In spite of this prominence however, within this body of literature, there is discord as to who overtly should be considered a PPP stakeholder and thus involved in these arrangements; across literature, 15 stakeholders have been proposed. Against this backdrop, it is argued, before these relationships can be improved, there is firstly a forthcoming necessity to address this disparity. To do this, this research adopts the rudiments of stakeholder theory to determine the attributes of stakeholders and the mechanisms by which to understand them. Following this, this will be contextualised to PPP, critically providing the essential building blocks on which to nurture improved stakeholder relationships. This research thus has three objectives: the first is to conceptualise stakeholder theory within the context of PPP, secondly, to identify PPP stakeholders, and finally to determine PPP stakeholder relationships.

STAKEHOLDER THEORY

The origination of stakeholders in literature can be recorded back to the Stanford Research Institute in 1963, appearing in an international memorandum, however Freeman (1984) is often credited with the introduction of stakeholder theory into the management arena with his landmark publication “Strategic Management: A Stakeholder Approach” (Donaldson and Preston, 1995). Stakeholder theory evolved out of corporate social responsibility, organisation theory, systems theory and corporate planning giving consideration to ethical, social and economic concerns. Freeman (1984) claimed stakeholder theory is centred on “the principle of who or what really counts”, offering approaches for organisational management to consider the interests of other parties. Donaldson and Preston (1995) demonstrated that stakeholder theory though essentially normative, can be divided into three theoretical taxonomies: 'descriptive' explains the behaviour and characteristics of the firm, and its

perception of others, 'instrumental' seeks to verify the linkage between organisations, whereas 'normative' describes the role of moral guidelines for operation and management of corporations. Within this paradigm, to understand stakeholders, stakeholder theory has commonly recruited the attributes of power and interest. Power is defined as the ability of an organisation to impose its will to bring about the outcomes which they desire (Salancik and Pfeffer, 1974) while interest pertains to levels of attention or involvement (OED, 2016). Equally, just as some have endeavoured to understand stakeholders, others have tendered several approaches to stakeholder identification. Though approaches remain somewhat disputed, the construct of legitimacy is commonly central to these systems. Freeman (1984) suggested that anyone with a stake who can affect the organisation should be regarded as being legitimate and subsequently is deserving of attention, regardless of the nature of their claims. Differently, Donaldson and Preston (1995) were of the opinion that legitimacy seeks to differentiate between those who can influence and those who have a moral claim. On the other hand, Philips (2003) argued that by possessing influence regardless of a moral claim, these parties, in line with the very notion of stake holding, cannot be excluded. Rather than discount these actors, he proposed a nomenclature of stakeholders consisting of normative, derivative and non-stakeholders. Normative stakeholders 'are those whom the organisation has a moral obligation', derivative are 'those whose actions and claims must be accounted for by managers due to their potential effects upon the organisation and its normative stakeholders', and non-stakeholders are those who possess neither influence nor a moral claim and can be excluded. Yet, just as this approach accounts for those with influence and those with claims, Phillips (2003) noted it may be difficult to distinguish between normative and derivative stakeholders.

Application of stakeholder theory to Public-Private Partnerships

To contextualise stakeholder theory to PPP, the fundamentals of this paradigm must be restructured. In stakeholder theory, its descriptive stance dictates the 'firm', i.e. the client, is the central organisation and thus their perception of others determines the involvement and management of these bodies. However, PPP differs from conventional provision models. Defined as an arrangement for the collaborative provision of a public service between the public and private sectors, organisations inherent to each sector share roles, responsibilities and financing. In turn, this blurs the conventional position of the client as the focal organisation (De Schepper *et al*., 2014). A PPP project can better be described as an 'environment' with multiple stakeholders and multiple relationships. As such, a social network analysis approach is more appropriate vis-à-vis the traditional stakeholder theory dyadic perspective. A social network analysis approach surpasses the limitations of the conventional focal organisation or its associated boundaries. Rather, it looks to the wider environment to understand connections between stakeholders, the nature of the linkages, and, the role that each stakeholder performs (Smyth and Pryke, 2008). Still, before these connections can be examined, from within these two broad bodies it must firstly be determined who PPP stakeholders are.

Returning to Phillips' (2003) notion of legitimacy, De Schepper *et al*., (2014) deemed the contractual relationship and relationships of the perception of norms, values and beliefs to be determinant in distinguishing normative and derivative Belgian PPP stakeholders. This research, similarly utilising Phillips' (2003) taxonomy, conversely argues that, relationships of norms, values and beliefs are subjective on the assertion these perceptions will differ predicated on your sectoral position. The private sector,

traditionally, is motivated by returns and profit and therefore holds different perceptions to that possessed by the public sector; who typically pursue improved social well-being. As a result, the only tangible measure can be the contract and an organisation's relationship with it.

Contingent on this understanding of legitimacy, this research identifies PPP normative stakeholders as the Authority and the Special Purpose Vehicle, and its constituent members. By contrast, all other stakeholders can be defined as derivative. However, it is noteworthy to consider Donaldson and Prestons' (1995) proffering, namely, stakeholder theory is fundamentally normative. It is therefore reasoned the key stakeholders are the Authority and the SPV, and its constituent members.

Authority

In PPP, unlike other procurement models, the Authority is the public sector organisation directly involved in the delivery of the infrastructure asset. It is traditionally driven by Value for Money (VfM), cost savings, improved services provision, and social and public benefits (Zou *et al*., 2013). In a change from the traditional transaction structure of PFI, PF2s initial operation in the PSBP will see the central government acts as the Authority, the Education Funding Agency (EFA). Through defining objectives and outcomes, the Authority can ensure the requirements of the project are achieved and thus safeguard the interests of the wider public. The Authority will, as Grimsey and Lewis (2004) describe, 'wear many "hats"' meaning they will fulfil a number of roles, including: defining the business case, determining output and performance requirements, planning and executing the procurement process, govern the contract, liaise with the community and co-operate with the SPV to overcome changes in the project. Notably, despite being directly involved in the project delivery, the Authority is ultimately accountable to central governmental departments and, essentially, parliament (Shaoul *et al*., 2012).

Special Purpose Vehicle

The private sector supplier is a consortium of organisations which collectively operate through a project company often referred to as a Special Purpose Vehicle (SPV) or project company. This is a commercial entity formed specifically by the cohort for the purpose of undertaking the project and is responsible for producing, funding and delivering the infrastructure asset (Grimsey and Lewis, 2004). The SPV negotiates and enters into a contractual agreement for the financing, designing, building, management and operating of the facility with the Authority. Its members enter into a contract between themselves and the SPV, rather than being directly contracted with the purchaser. In doing so, this allows the supplier to bundle together solutions and specific skillsets needed across differing phases of the project (Roehrich and Caldwell, 2012). This facilitates the achievement of economies of scale, innovation and risk sharing among other benefits. This consortium is traditionally commercially pursuant seeking; profitability and increased revenue (Zou *et al*., 2013) and comprises financiers and contractors.

Debt holders

Debt holders are commonly sourced from financing institutions such as banks, infrastructure funds or institutional investors, and their interests are centred on consistent returns, however, more recently the balance of these institutions has shifted. With the decline of the debt market resonant of the Global Financial Crisis (GFC), the introduction of new banking regulations and the decline of the monoline insurance market has made it increasingly difficult to raise debt financing. As such, the notion

of attracting alternative sources of finance is currently prevalent with HM Treasury (2012) encouraging increased earlier involvement, particularly from institutional investors such as pension schemes and insurance funds. The number of lenders in an already limited market has lessened, affecting both debt provision and lending to equity investors.

Equity holders
These are commonly constituted from SPV members for legal and accounting purposes appointed with the responsibilities of the development, construction, and operation of the facility, contracted with the SPV. Additionally, third party equity investors may also directly invest in the project. Post construction, it is not uncommon for equity and debt holders to sell off shares to secondary markets or refinance their investments at lower interest rates (Demirag *et al*., 2015). Furthermore, PF2 will now see the inclusion of a central public sector equity stakeholder positioned within the SPV.

Contractors
These typically include design and build (D&B) contractors, facilities management (FM) contractors and often other specialist contractors (Grimsey and Lewis, 2004). Though many of these contractors may be equity holders, their remits lay in the provision and delivery of the asset. D&B contractors work to an output specification and are granted the freedom to design innovative solutions. Typically, their roles and responsibilities include collaborating with the Authority and other SPV stakeholders to design and construct the facility. These contractors usually have short term objectives: seeking to maximise profits and the flexibility to move onto other projects post construction (Demirag *et al*., 2015). Different to traditional procurement, PPP holds greater importance for operational contractors. The facilities management (FM) contractor's roles involve inputting into the design and liaising with the D&B contractors, collaborating with the Authority, and ultimately being entrusted with the responsibility of operations of the infrastructure (Hardcastle and Boothroyd, 2003). Their mandate is to ensure the effective life-cycle functioning of the asset (Consoli, 2006).

FINDINGS

Applying a stakeholder theory social network perspective coupled with the attributes of power and interest to PPP, figures 1, 2 and 3 have been constructed. These figures delineate the transitional relationships between PPP stakeholders. Stakeholder relationships are identified as altering in the procurement, construction and operational phases.

Within these phases, two relational dynamics have been recognised. This is the macro-level relationship; the formalised contractual agreement between the Authority and the SPV. This is represented by the arrowed line. In addition to this on-going long-term arrangement, there are also micro relationships. These secondary relationships comprise interactions within the SPV, and between SPV members and the Authority. This is signified by a single line.

Macro-level relationship
The macro-level relationship exists between the Authority and the SPV. This is an on-going dyad that will run for the duration of the project, though literature signposts the principal dynamic shift in this relationship occurs at financial close as both parties become contractually bound (Chinyere and Xu, 2012).

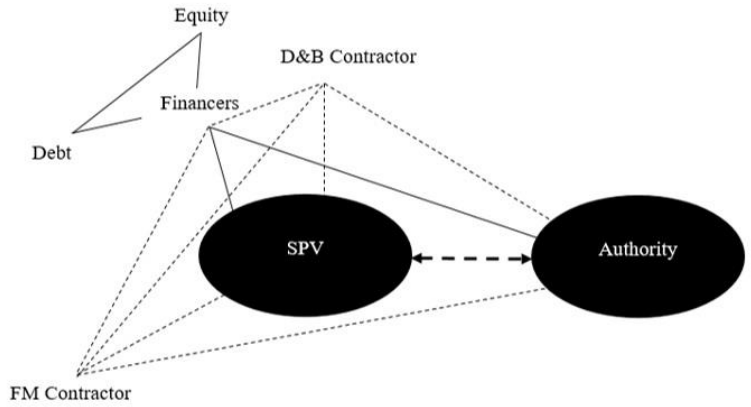


Figure 1: PPP stakeholder relationships in the procurement phase

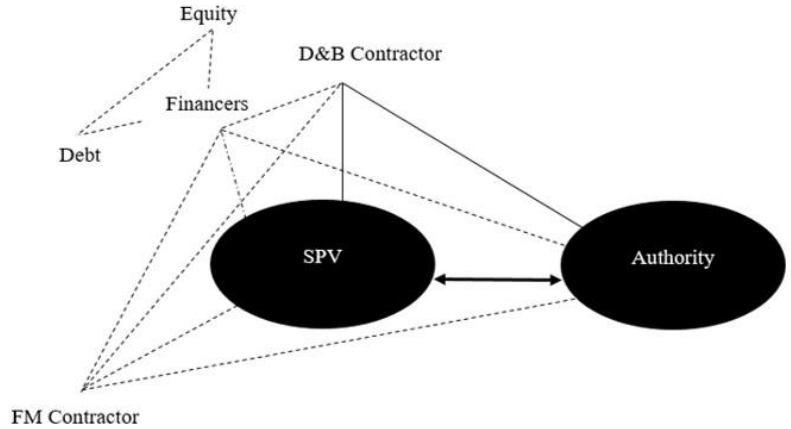


Figure 2: PPP stakeholder relationships in the construction phase

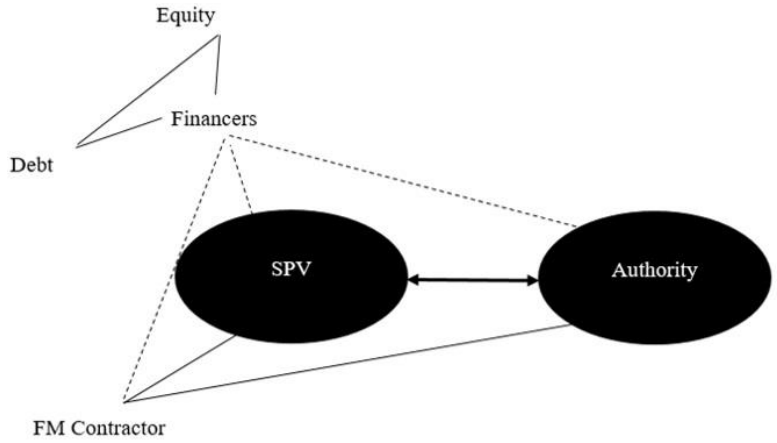


Figure 3: PPP stakeholder relationships in the operations phase

Pre-financial close (figure 1), the nature of the environment is commercially charged as the Authority seeks to encourage competition to maximise VfM (Barlow and Köberle-Gaiser, 2008). This is represented through the broken arrowed line. The Authority is responsible for undertaking tasks including: defining the required service, appraising of project viability and evaluating alternatives, producing a business case,

and commencing the project development (Grimsey and Lewis, 2007). SPV teams compete for the project, with a preferred bidder being selected to enter into contract negotiations (Barlow and Köberle-Gaiser, 2008). Leading up to financial close, the nature of this relationship is tentative, with little security of project progression, however, as both organisations approach a contractual agreement, the platforms of the purchaser/provider, together with the dynamics of the relationship transition (Barlow and Köberle-Gaiser, 2008). Previously, both organisations are separate entities, however, through formalising the contract, both stakeholders agree to enter into a partnership for the collective delivery and management of the project. The construction of these sustainable relationships becomes critical in that these stakeholders are now reliant upon each other for the project success. This is indicated through the solidifying of the broken arrowed line.

Micro-level relationship

While the macro relationship is somewhat straightforward, comparatively, the micro arrangements are much more intricate and complex. Under threat of potentially incurring monetary penalties for poor asset provision, the nature of the internal SPV relationships are performance orientated. Pursuing economic advantage, consequently, every stakeholder's actions affect all other SPV stakeholders. Though there is continual interaction between all stakeholders across all stages of the project, to understand PPP micro relationships it is pertinent to return to Roehrich and Caldwell's (2012) aforementioned assertion: i.e. the SPV will unbundle roles and responsibilities contingent upon the project phase. By virtue of this 'unbundling' of tasks, differing SPV stakeholders' power and interests will transition and thus determine stakeholder relationships not only inherent to the SPV, but also corresponding to the Authority. Therefore, in addition to internal SPV networks, micro relationships are also constituted from SPV member-Authority arrangements.

In the procurement phase, though the D&B, and FM contractors are involved, they are lesser roles comparative to the front-ended financier involvement (Zheng *et al*., 2008). This heavy early involvement may be explained by the high levels of uncertainty and risks in the procurement phase prior to financial close (Chinyere and Xu, 2012). This reasoning is pertinent when coupled with Demirag *et al*., (2015) who claimed that, conventionally, debt funders are risk adverse; seeking to balance risk/reward profiles. Chinyere and Xu (2012) asserted project lenders, in the earlier phases, are instrumental; undertaking strong supervisory roles pertaining to design, organising the SPV, negotiating arrangements with the Authority, and positioning constituent stakeholders. On these grounds, the financial stakeholders possess high levels of both power and interest. This relational dimension is reflected through the solid line exhibited between the financiers, the SPV, and the Authority in figure 1. The auxiliary roles, i.e. D&B and FM contractors, are represented through the broken lines on the grounds that these stakeholders are not yet directly involved in the provision and delivery of the service and therefore possess lower levels of power and interest.

Following financial close, micro relationships shift. Having secured the project, financier interests lessen; reflected through the broken line. Though there are still high levels of risk during the construction phase, these can be mitigated and managed through fixed price contracts (Burke and Demirag, 2015; Demirag *et al*., 2015). Notably, however, when a risk of delay is presented jeopardising returns, the interests of financiers can shift manifested through the exertion of pressure on other SPV stakeholders. This is also the case during operations (Zheng *et al*., 2008). Accordingly, the dimensions of the SPV will evolve. Different to the procurement

phase, D&B contractors are now directly involved and thus possess high levels of interest and power. The D&B contractors are typically responsible for the provision and commissioning of the asset. Determined by an output specification, the D&B contractors will collaborate with the Authority and other SPV stakeholders to construct the asset on time and within budget (Roehrich and Caldwell, 2012). During construction, again similar to the procurement phase, the FM will have input, although, they have no direct involvement in the provision of the asset. These dimensions are reflected in figure 2. The solid lines between the D&B contractors, the Authority and the SPV indicate these dynamics in the construction phase.

Having completed its mandate of designing and building the facility, the project will progress to the operational phase (figure 3). FM interest and power will increase as this stakeholder is responsible for the performance of the asset. This is exhibited by the changing relationships between themselves, the SPV and the Authority (Roehrich and Caldwell, 2012). Following construction, the profile for risk is dramatically reduced. There is resultantly little requirement for direct financial involvement and thus little interest. However, as before mentioned, while this is not always the case, it is common for debt and equity holders to refinance or sell off their shares to a secondary market (Demirag *et al*., 2015). It is common for 'bond shareholders' such as pension or insurance funds to enter a project, replacing primary financiers. These stakeholders are typically risk adverse, preferring not to invest until the asset is operational, avoiding construction risks and uncertainties (Buchanan *et al*., 2014). Likewise, equity shares are often sold by the constructors to other SPV stakeholders or less active third-party equity investors as they seek to recycle funds to grant them the freedom to move onto other projects (Demirag *et al*., 2015). Reduced risk, little involvement, re-financing as well as the entering of secondary market financiers, the interests in the provision of the asset of financiers remain low and as such is represented through staggered line. However, the relationships and interests within this stakeholder grouping are changing. This dynamic is represented through the solid line between 'debt', 'equity' and 'financier' stakeholders. Furthermore, D&B contractors, selling off their equity investments and moving onto other projects, have been removed from the diagram.

RESEARCH IMPLICATIONS

Within PPP, stakeholder relationships have been discerned as a primary source of poor project performance. Appropriately, the topics of relationships, relationship management and collaboration are currently prevalent. Still, despite this growing body of literature, the fundamentals of these arrangements are not yet fully understood or defined. PPP arrangements differ from traditional procurement as a result of the sharing of roles and responsibilities. A manifestation of this blurring has been little agreement between PPP stakeholders. It is argued, there is a knowledge gap pertaining to PPP stakeholders meaning existing literature fails to effectively address many of the inherent relational issues. This research addresses this knowledge gap and has two significant implications. Firstly, it offers an original PPP framework grounded in stakeholder theory to identify and understand stakeholders. In doing so, this research offers a set of principles, as opposed to a definitive list which runs the risk of excluding potential future stakeholders. Indeed, an example of this is apparent in the introduction of PF2. PF2 will now see a central public sector body now directly invest into project equity. Though deemed to still be in its infancy, by employing this study's definition of legitimacy, this organisation can be determined as a stakeholder. Secondly, utilising this framework, this research applies these principles to existing

literature. Centred on legitimacy, PPP stakeholders have been identified. Equally, adopting the constructs of power and interest, the study has provided an understanding of these stakeholders, in turn contributing the essential building blocks of these relationships to inform future research. The UK government has declared its commitment to PPP and no doubt future variants of these models will continue to be mechanised. As PPP models continue to develop and evolve in the UK, this potentially will bring about new stakeholders. As such, this will see the evolution of existing relationships but also significantly the creation of new unknown dynamics. Nevertheless, through the application of this framework, despite the advancement of future PPP arrangements, these stakeholders can continue to be identified and understood.

CONCLUSION

This investigation, grounded in stakeholder theory has contributed to knowledge by not only providing an original insight into existing PPP stakeholder relationships, but also by contributing a set of principles to understand future arrangements. By doing so, this study provides the vital foundations to inform future PPP stakeholder relationship research.

REFERENCES

Barlow, J and Köberle-Gaiser, M (2008) Delivering innovation in hospital construction: contracts and collaboration in the UK's private finance initiative hospital program. *California Management Review*, **51**(2), 1-18.

Buchanan, A, Clifford, A, Fleming, C, Harding, T, Hitchins, J, Poole, V, van der Tas, L, Tucker, G, Vaessen, M and Watchman, A (2014) *Unlocking Investment In Infrastructure: Is Current Accounting And Reporting A Barrier*? B20 Panel of six international networks.

Burke, R and Demirag, I (2015) Changing perceptions on PPP games: Demand risk in Irish roads. *Critical Perspectives on Accounting*, **27**, 189-208.

Chinyere, I and Xu, X (2012) Public-private partnerships: The underlining principles of infrastructure investment, finance and development projects. *International Journal of Business and Management*, **7**(1), 109-125.

Consoli, G (2006) Conflict and managing consortia in private prison projects in Australia - Private prison operator responses. *International Journal of Project Management*, **24**(1), 75-82.

De Schepper, S, Dooms, M and Haezendonck, E (2014) Stakeholder dynamics and responsibilities in public-private partnerships: A mixed experience. *International Journal of Project Management*, **32**(7), 1210-1222.

Demirag, I, Kkadaroo, I and Stapleton, P (2015) A changing market for PFI financing: Evidence from the financiers. *Accounting Forum*, **39**, 188-200.

Donaldson, T and Preston, L E (1995) The stakeholder theory of the corporation: Concepts, evidence, and implications. *Academy of Management Review*, **20**(1), 65-91.

Freeman, R (1984) *Strategic Management: A stakeholder approach*. Boston: Pitman.

Grimsey, D and Lewis, M K (2004) *Public private partnerships: The worldwide revolution in infrastructure provision and project finance*. Cheltenham, UK: Edward Elgar Publishing.

Hardcastle, C and Boothroyd, K (2003) Risks overview in public-private partnership. *In*: A Akintola, M Beck and C Hardcastle (Eds.) *Public-Private Partnerships: Managing Risks and Opportunities*. Oxford: Blackwell Science Ltd, 31-57.

HM Treasury (2016) Private Finance Initiative and Private Finance 2 Projects: 2015 Summary Data. London: HMSO.

HM Treasury (2012) *A New Approach to Public Private Partnerships*. London: HMSO.

HM Treasury (2011) *National Infrastructure Plan 2011*. London: HMSO.

Inderst, G and Stewart, F (2014) *Institutional Investment in Infrastructure in Emerging Markets and Developing Economies*. Public-Private Infrastructure Advisory Facility, Washington D.C: World Bank Group.

National Audit Office (2015) *The Choice of Finance for Capital Investment*. London: National Audit Office.

Oxford English Dictionary (2016) Available from http://www.oxforddictionaries.com/definition/english/interest [Accessed Wednesday 8th June 2016]

Phillips, R (2003) Stakeholder Legitimacy. *Business Ethics Quarterly*, 13(1), 25-41.

Phillips, R, Freeman, R and Wicks, A C (2003) What stakeholder theory is not. *Business Ethics Quarterly*, 13(4), 479-502.

Raganelli, B and Fidone, G (2007) *Public Private Partnerships and Public Works: Reducing Moral Hazard in a Competitive Market*. Social Science Research Network.

Roehrich, J and Caldwell, N (2012) Delivering integrated solutions in the public sector: the unbundling paradox. *Industrial Marketing Management*, **41**(6), 995-1007.

Roehrich, J, Lewis, M and George, G (2014) Are public-private partnerships a healthy option? A systematic literature review. *Journal of Social Science and Medicine*, 113, 110-119.

Salancik, G and Pfeffer, J (1974) The bases and use of power in organizational decision making: The case of a university. *Administrative Science Quarterly*, **19**(4), 453-473.

Shaoul, J, Stafford, A and Stapleton, P (2012) Accountability and corporate governance of public private partnerships. *Critical Perspectives on Accounting*, 23(3), 213-229.

Smyth, H and Pryke, S (2008) *Collaborative Relationships in Construction: Developing Frameworks and Networks*. Oxford, UK: Blackwell.

World Economic Forum (WEF) (2016) *The Global Competitiveness Report 2015- 2016*. Geneva: World Economic Forum.

Zheng, J, Roehrich, J and Lewis, M (2008) The dynamics of contractual and relational governance: Evidence from long-term public-private procurement arrangements. *Journal of Purchasing and Supply Management*, 14(1), 43-54.

Zou, W, Kumaraswamy, M, Chung, J and Wong, J (2013) Identifying the critical success factors for relationship management in PPP projects. *International Journal of Project Management*, **32**(2), 265-274.

ENGAGEMENT STRATEGIES AND CHALLENGES FOR ADOPTION OF STAKEHOLDER MANAGEMENT APPROACHES (SMA) IN SOUTH AUSTRALIAN CONSTRUCTION INDUSTRY: PRELIMINARY OBSERVATIONS

Janet A Ochieng[1] and Nicholas Chileshe[2]

[1] *Ministry of Public Service, Youth and Gender, P.O. Box 43-50200, Bungoma, Kenya*

[2] *School of Natural and Built Environments, University of South Australia, GPO Box 2471, Adelaide, South Australia 5001, Australia*

With a focus on internal stakeholder management approaches (SMA), engagement strategies and challenges have been suggested in literature. However, there is a paucity of studies in relation to external stakeholders and in particular, South Australia. This paper aims to investigate the engagement strategies and challenges affecting the external stakeholders in adopting SMAs. 21 engagement strategies and 9 challenges were identified through a literature review, and consolidated by 5 interviews. A questionnaire instrument containing these 21 engagement strategies and 9 challenges were sent out to project management practitioners in South Australia, and 19 completed questionnaires were retrieved. The top three ranked strategies for SMAs were "stakeholder identification", "well defined communication strategy and plan", and "stakeholder expectations are understood". The least ranked were "open information sharing", and "delegating responsibility to the stakeholder". The top three challenges were "conflicting agendas", "scarce resources", and "power conflicts". In contrast, the least ranked three challenges were: "subversive stakeholders", "passive involvement of stakeholders", and "low turn out to meetings". Strategies identified from the interviews included identifying stakeholders as early as the design phase of the projects. This study provides insights and raises awareness on the engagement strategies and challenges for the effective adoption of stakeholder management approaches.

Keywords: South Australia, stakeholder management, engagement strategies, mixed methods, descriptive statistics

INTRODUCTION

Stakeholders in any project can be of benefit or threat to the project's objectives depending on how they are engaged with by the project manager, the project team and the organization. Synchronizing these issues to implement the project successfully can become a challenge to the project manager. A stakeholder has been defined as an individual or group of people that can affect or be affected by the project (Assudani and Kloppenborg, 2010). Project Management Institute, PMI (2013, p.391) defines a stakeholder as 'an individual, group or organization who may affect, be affected by, or

[1] janetochieng78@yahoo.com

Ochieng, J A and Chileshe, N (2016) Engagement Strategies and Challenges for Adoption of Stakeholder Management Approaches (SMA) In South Australian Construction Industry: Preliminary Observations. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 873-882.

perceive itself to be affected by a decision, activity, or outcome of a project'. By including the stakeholder who perceives that a project can affect them, greater uncertainties in a project arise and make it difficult to plan the management of such a stakeholder. Furthermore, stakeholders have the power to be of benefit or prove as threat to project depending on how they view it and their interest can prove to be difficult to document. Inadequate attention to their concerns leads to differences and disagreements throughout the project life cycle. The significance of stakeholders is well documented in literature (Olander and Landin, 2005; Yang *et al*., 2009b). For example, Landin (2000 cited in Yang *et al*., 2009b) linked the long term performance of any construction and its ability to satisfy stakeholders as being dependant on the decisions made in stakeholder communication. In most instances, project implementers view external stakeholders as a barrier to achieving the project objectives. Earlier studies such as Aaltonen and Kujala (2010); Olander and Landin (2005) had recommended the inclusion of all stakeholders since the project affects both their society and surroundings. Both studies had also highlighted the influence of stakeholders through their linkages to project outcomes. For example, Olander and Landin (2005) showed that understanding external stakeholders therefore helps to forge a relationship thus arresting any misconceptions and assumptions before they escalate to the point of affecting the project. Similarly, Aaltonen and Kujala (2010) reported that the understanding and involement of stakehoders also reduces operational costs and consequently, the undesirable impacts on the project.

In spite of several research on stakeholder management being done, they have generalized the concept of stakeholder management. Furthermore, some of the South Australian specific studies have investigated the social forces that shape perceptions of risk and sustain *community-based protest* projects (Teo and Loosemore, 2010). However, with the exception of the Baroudi and Rapp (2014) study which focused on disaster restoration projects, construction specific stakeholder engagement studies within the context of South Australia are very limited. A review by Aaltonen and Kujala (2010) verified that most studies have been on the internal stakeholder leaving a gap on the external stakeholder. Therefore, a need to explore the engagement strategies and subsequent challenges associated with the stakeholder management approaches in South Australia becomes relevant. The present study is aimed at filling the knowledge gap by conducting a survey among construction professionals' in South Australia. It is aimed at eliciting perception, identifying, evaluating and ranking the choices of stakeholder management engagement strategies and challenges associated with the implementation of the stakeholder management approaches. The upshot of the study will result in pinpointing the best strategy for effective management in order to achieve the expected outcome.

The following is an overview of some of the approaches to stakeholder engagement and their associated challenges. A brief summary of discussions is provided on the extant literature on the approaches to stakeholder theory; external stakeholder management approaches; challenges affecting the external stakeholders in adopting stakeholder management approaches (SMAs), and the knowledge gape. This is followed by the methodological approach adopted, a discussion of the findings and implications of the study. Some advocated engagement strategies and challenges for the effective adoption of stakeholder management approaches are also suggested. The final section concludes with recommendations and conclusions drawn.

REVIEW OF LITERATURE

Table 1 presents a summary of studies undertaken on the following: (1) stakeholder concept; (2) Stakeholder management in the project life cycle (PLC); (3) stakeholder theory; (4) stakeholder influence strategies; and (5) stakeholder management approaches (SMA) including the (6) associated challenges. The selected studies were narrowed down to the year of publication ranging from 2003 to 2013 in order to obtain the current studies. It should further be noted that a number of stakeholder management approaches and necessary skills for stakeholder engagement have been proposed in literature. From the literature review and examination of Table 1, it is evident that stakeholders, whether internal or external, are a component that project management must include in their plans to get forecasted results. A number of studies such as Aaltonen and Kujala (2010); Chinyio and Olomolaiye (2009) have provided the following interpretation of 'internal' and 'external' stakeholders: "internal stakeholders are those who have a formal association with the project while external stakeholders do not have any formal relationship with the organization but, when their issues are not handled, can become potential threat to the project results". Despite the classification provided, Table 1 shows that the majority of studies have concentrated on the internal stakeholder than the external stakeholder as evidenced by frequency of studies reviewed with 93% against 33% for each category. Secondly, the execution and operation phases of a project have equally received minimal attention with 27% and 13% of the studies reviewed respectively compared to 53% for planning phase. This resulted from the ability to change the designs and decisions made about a project. Several authors consider stakeholders a threat (27%) to the organization hence the adoption of instrumental approach management strategies (33%) compared to 20% of normative theory.

RESEARCH METHODS

To investigate the perception of project management professionals on the engagement strategies and challenges associated with adopting stakeholder management approaches (SMAs) when engaging with external stakeholders, the following mixed research methods were employed in the study.

Measurement instrument: Quantitative approach (questionnaire design)

The questionnaire survey was distributed to the South Australian project management organisations (SAPM) comprised three distinct sections as follows: Section 1 encompassed general demographics; Section 2 comprised four subsections (2a; 2b; 2c and 2d) as follows: Subsection (2a) was aimed at ascertaining the number of external stakeholders that the organisation had relationships; (2b) was focussed on the 'stakeholder analysis' and designed at evaluating the varying degrees of the impact of the stakeholders; (2c) comprised the 21engagement strategies, and (2d) had the 9 challenges influencing the effective implementation of SMA. Subsections (2c and 2d) formed the basis of this paper. These were further compared with previous studies as summarised in Table 1. The third and final section was designed at evaluation of the measurement of the project outcomes. Given that both industry associations have branches in every state in Australia, specific instructions were included within the questionnaire indicating who the targeted respondents were. In particular, questionnaires used in studies conducted by Olander and Landin (2008) and Yang *et al.*, (2009a) were refined and adopted for this study. While previous studies such as Yuan *et al*., (2011) identified the criticality of their variables by deeming those with mean values of greater than 3.00 as important or critical, our study conducted the

analysis -T-test of the mean to measure the significance of the 'engagement strategies' and 'challenges' affecting the adoption of SMA. Drawing upon Ling and Nguyen (2013), the cut off point for 5–point scale was set at "3.5" ($\mu = 3.5$), and the hypothesis introduced to measure the criticality of the variables under investigation. The findings reported here relate to only the first and part of the second section (subsections 2c and 2d) of the questionnaire dealing with the engagement strategies and challenges. It was also beyond the scope of this study to report all the results.

Data analysis

This paper seeks to investigate the perception of project management professionals 'on the on the engagement strategies and challenges affecting the external stakeholders in adopting SMAs in South Australia. For the quantitative data from the questionnaire survey, the *Statistical Package for Social Sciences* (SPSS) computer program was also used to analyse the data generated by the research questions. In order to analyse the data as provided by the questionnaire, the following three types of analyses were used: (1) frequency analysis; (2) ranking analysis; and (3) relative importance index (RII). Such approaches have been adopted before in survey and stakeholder management related studies (Yang *et al*., 2009b).

Reliability analysis

The measurement instrument was also tested for validity and internal consistency. According to Cronbach (1951 cited in Nunnally, 1978), one of the most popular reliability statistics is the Cronbach alpha. This was found to be 0.929 (F-statistic = 2.936, sig. = 0.000); and 0.829 (F-statistic = 7.011, sig. = 0.000) for the 'engagement strategies' and 'challenges' sub instruments respectively. The Cronbach values were greater than 0.7, thus conforming the high reliability of the measurement sub-instruments (Nunnally, 1978).

Population and sampling

The questionnaire survey distributed in July 2014 using Survey Monkey and link sent to Australian Institute of Project Management (AIPM) and Project Management (PMI) so that members who logged on would complete and respond. The link was also embedded in the end of month newsletter that is sent by mail to all AIPM members. This survey was left open for a period of 45 days. This study used ordinal scales in order to rank the data gathered from the respondent established on the Relative Importance Index (RII). By the end of the survey period, 19 responses were received. Being a web-based survey, the response rate is incalculable due to unknown potential respondents who actually receive and examine the document provided (Rhodes *et al*., 2003).

Characteristics of the sample

The respondents to the questionnaire survey comprised eight senior managers (42.1%), an equal number three of project managers (15.8%), one senior engineer (5.3%), and an equal number two general managers and "others" category (10.5%). Of these, 13 had more than 6-10 years' experience (68.4%), five of them with 16-20 years (26.3%) and one with more than 26 years (5.3%). Based on the type of organisation, the majority 9 (47.4%) clients (private and public); 5 (26.3 %) contractors, 4 (21.1 %) consultants. Sector wise, the majority 13 (68.4%) were public organisations and 5 (26.3%) private. These findings are indicative of a variety of respondents in terms of the positions in the organization. Further, it could thus be inferred that the majority of the respondents were involved in the provision of

technical, operational and strategic perspectives of stakeholder management in the study. However, it's evident regarding the proliferation of senior managers and the limited number of project managers as employed in the study sample. As opined by Rhodes *et al.*, (2003) study, sample representativeness was identified as one of the challenges faced in web-based surveys. However, it is assumed that all of the respondents have had some experience in projects.

Qualitative approach: Interviews

Interviews were used to supplement the findings from the questionnaire survey and to obtain in-depth views from the project management practitioners in South Australia.

Table 1: Summary of selected literature on stakeholder management factors

Stakeholder management factors (SMA)	References															No.	F *(%)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
Stakeholder concept																	
Internal	√	√	√	√	√	√	√	√	√	√	√	√	√		√	14	93
External		√	√		√								√	√		5	33
Potential benefit to the project						√										1	7
Potential threat to a project		√		√		√				√						4	27
Stakeholder management in the PLC																	
Planning phase		√	√	√		√		√	√					√		8	53
Execution phase	√	√		√										√		4	27
Operation phase	√	√														2	13
Stakeholder theory																	
Descriptive																0	0
Instrumental		√			√	√				√						5	33
Normative			√	√						√						3	20
Stakeholder influence strategies																	
Grassroots' collective action		√	√				√		√					√		5	33
Crowd behaviour theory		√					√		√							3	20
Critical mass, threshold and diffusion theory		√					√		√					√		4	27
Resource mobilisation theory		√					√		√							3	20
Political opportunity theory							√									1	7
Stakeholder management approaches																	
Stakeholder classification		√	√		√					√	√			√		6	40
Stakeholder engagement			√		√						√	√				5	33
• Communication			√	√				√	√	√	√			√		7	47
• Relationship building			√		√	√		√				√	√			6	40
• Conflict management		√	√			√					√			√	√	5	33
• Assigning roles to stakeholders					√	√										2	13
Analysing change in stakeholder influence				√						√						2	13
Challenges in stakeholder management approaches								√								1	7

Notes: 1. *Zou et al.* (2007); 2. Aaltonen and Kujala (2010); 3. Olander and Landin (2005); 4. Sutterfield *et al.* (2006); 5. Beringer *et al.* (2012); 6. Yang *et al.* (2009); 7. Teo and Loosemore (2010); 8. McGurk *et al.* (2006); 9. Edelenbos *et al.* (2011); 10. Chanyio and Olomolaiye (2009); 11. Bourne (2008); 12. Vaagaasar (2011); 13. Aaltonen *et al.* (2010); 14. Olander and Landin (2008); and 15. Jonas (2010); *F = Frequency

A semi-structured interview approach was used aimed at capturing views around the engagement strategies and associated challenges. The information collected was transcribed and analysed through an iterative review process.

The profile of interviewees according to their positions were as follows: Certified practising project director **(R1)**; Lead planning coordinator **(R2);** Senior project manager **(R3);** Stakeholder engagement advisor **(R4)**; Team leader for design projects **(R5)**. This level of expertise demonstrates that all interviewees were at management level in their organizations and provided vast depth of knowledge on project management and in particular, stakeholder management. Secondly, their years of experience ranged from 9 to 32 years with an average age of 20.2 years. The interviews had also managed projects ranging from 1.5$m to 1.2$bn. Relative to the type of organisations, three of the interviewees were from the client's; and one each was from contracting and consulting sector.

Table 2: External stakeholder management approaches critical to project outcomes

Code	Engagement strategy	t-value ($\mu = 3.5$)	Sig (2-tailed)	Mean	Std. Dev	RII	Rank
Anl1	Stakeholder identification	11.180	0.000	4.750	0.4472	0.950	1
Com1	Well defined communication strategy and plan	9.922	0.000	4.688	0.4787	0.938	2
Anl2	Stakeholder expectations are understood	9.922	0.000	4.688	0.4787	0.938	2
Rb2	Leadership	7.889	0.000	4.688	0.6021	0.938	4
Cofm3	Timely action on criticism	9.000	0.000	4.625	0.5000	0.925	5
Eplc4	Project performance standards are identified and communicated	7.268	0.000	4.625	0.6191	0.925	6
Eplc3	Stakeholder needs and expectations are addressed	6.204	0.000	4.571	0.6462	0.914	7
Rb1	Trust and collaboration	5.842	0.000	4.563	0.7274	0.913	8
Com3	Stakeholders are properly informed on project progress	7.746	0.000	4.500	0.5164	0.900	9
Eplc1	Stakeholders involved at the initiation phase of the project	6.325	0.000	4.500	0.6325	0.900	10
Com5	Efficient flow of information	7.319	0.000	4.438	0.5124	0.888	11
Com4	Regular communication with stakeholders	5.960	0.000	4.438	0.6292	0.888	12
Anl3	Assess the stakeholder salience	5.960	0.000	4.438	0.6292	0.888	12
Cofm1	Collaboration among stakeholders	4.869	0.000	4.375	0.7188	0.875	14
Cofm2	Proactive interaction with stakeholders affected	6.789	0.000	4.313	0.4787	0.863	15
Anl4	Evaluate and understand stakeholder behaviour	6.789	0.000	4.313	0.4787	0.863	15
Com7	Open communication channels established and utilized	5.398	0.000	4.313	0.6021	0.863	17
Eplc2	Stakeholders are allowed to contribute to the project	4.097	0.001	4.313	0.7932	0.863	18
Com6	Clear and planned agenda of meetings	5.196	0.000	4.250	0.5774	0.850	19
Com2	Open information sharing	3.020	0.009	4.188	0.9106	0.838	20
Rb3	Delegating responsibility to the stakeholder	0.627	0.540*	3.688	1.1955	0.738	21

Notes[1]*: Engagement strategy codes where Anl = Stakeholder analysis; Com = Communication; Eplc = Engagement in relation to project life cycle; Rb = Relationship building; Cofm = Conflict management; * results not significant ($p > 0.05$)*

SURVEY RESULTS AND DISCUSSION

Ranking of engagement strategies

The respondents were asked to rate their opinions on these 21 'engagement strategies' using a five point Likert-scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree). Table 2 shows the results of these mean agreement responses, t-values and sig (2-tailed).

For ease of discussion, only a few selected strategies are discussed here. Based on the mean scores and RII, stakeholder identification was the highest ranked strategy (mean = 4.50; RII = 0.950). This finding is also consistent with SMA literature regarding the strategies (Kivits 2011; Vaagaasar, 2011). Examination of Table 2 shows that with the exception of "Delegating responsibility to the stakeholder" (t (15) = .629, p = 0.540 > 0.05), the mean values of the remaining 20 engagement strategies are significantly different from t-test value of 3.500.

In order to enhance the validation of the results, the findings from the quantitative study were triangulated with those from the qualitative approach. The interviewees were asked to identify some of the external stakeholders involved in their projects, the forms of interaction used and the frequency of such interactions. The most common external stakeholders identified from the qualitative study included the following: (i) Local aboriginal community; (ii) State and local government; (iii) Environmental Protection Authority (EPA); (iv) Property owners; (v) Business owners; (vi) Media; and (vii) Special interest groups. Well defined communication strategy and plan and 'stakeholder expectations are understood' were the second ranked SMA strategies (mean = 4.688; RII=0.938). Communication strategies that foster positive suggestions on alternative approaches to project execution are well acknowledged in literature (Aaltonen and Kujala, 2010; Olander and Landin, 2005; McGuk *et al*., 2006; Teo and Loosemore, 2010). Similarly, Teo and Loosemore (2010) emphasise this arguement and states that the project manager should therefore effectively engage with hidden reservoirs of power exercised by stakeholders by addressing their concerns throughout the PLC.

Ranking of stakeholder management approaches challenges

Table 3 shows the mean agreement responses, t-values and sig (2-tailed) for the 9 stakeholder management challenges.

Table 3: Challenges faced in stakeholder management approaches (SMA) adopted

Codes[1]	Stakeholder management challenges	t-value (μ = 3.5)	Sig (2-tailed)	Mean	Std. Dev	RII	Rank
SMC1	Conflicting agendas	9.922	0.000	4.688	.4787	0.9375	1
SMC4	Scarce resources	5.155	0.000	4.500	.5164	0.9000	2
SMC8	Power conflicts	7.746	0.000	4.438	.5124	0.8875	3
SMC3	Resistance to change	7.319	0.000	4.438	.7274	0.8875	4
SMC2	Hidden intents	7.000	0.000	4.375	.5000	0.8750	5
SMC6	Lack of extensive client participation	3.478	0.003	4.125	.7188	0.825	6
SMC9	Passive involvement of stakeholders	1.373	0.190*	3.813	.9106	0.7626	7
SMC7	Subversive stakeholders	2.267	0.039	3.938	.7720	0.7876	8
SMC5	Low turn out to meetings	0.280	0.783*	3.563	.8921	0.7126	9

***Notes**: [1]SMC = Stakeholder management challenge; * Examples included use of surveys, reports, press release and news conference*

Based on the mean scores, conflict agendas was the highest ranked challenge (mean = 4.688; RII =0.93575). This finding is also consistent with SMA literature regarding the associated challenges (Pan, 2005; Teo and Loosemore, 2010; Yang *et al*., 2009b; Cuppen *et al*., 2016). For instance, Pan (2005) identified that, during project execution, power conflicts can arise due to the kind of interaction among the stakeholders or from the influence of other stakeholders. Maintaining good relationships between the project manager and the external stakeholders was found to

expedite the process of conflict resolution since both parties are aware of the project's progress and its impacts. Similarly, Cuppen *et al*., (2016) acknowledged the existence of uncertainties and disagreements among stakeholders. 'Scare resources (mean = 4.500)' and 'power conflicts (mean = 4.438)' were the second and third ranked challenges respectively. Interestingly, examination of Table 3 shows that with the exception of "Passive involvement of stakeholders" (t (15) = 1.373, $p = 0.190 > 0.05$), and "Low turn out to meetings" (t (15) = 0.280, $p = 0.783 > 0.05$), the mean values of the remaining 7 challenges are significantly different from t-test value of 3.500.

Relative to the second challenge of "scarce resources", the study by Olander and Landin (2008) drew similar conclusions. This finding was also reinforced by **Interviewee R5** who appreciated the strategic decision of the management to intentionally allocate resources for the management of the stakeholders on the project that he was involved in. Similarly, Aaltonen and Kujala (2010) observed that perceptions of parties involved in a project contribute highly to conflicts. Conflicts can be a strategy that the stakeholder adopts to influence decisions. For example, all the interviewees noted that stakeholders who have power such as the regulatory authorities were considered more important. Some of the challenges were further also reinforced by the interviewees as discussed in the following subsection.

Strategies in overcoming the challenges

The interviewees were asked the specific alternatives that they had used to overcome some of the challenges. **Interviewee R1** suggested the inclusion of the stakeholders, people, and ensuring that the right information was provided in response to '*conflicting agendas*'. Similarly, the issue of dealing with '*anger*' among the stakeholders which was manifested in the '*conflicting agendas*', **Interviewee R3** recommended the following: "*Deal with anger and do not take it personally; for those unhappy with the project, management them by talking about it; knock on the doors and talk to the people; manage all competing agenda so that everyone feels they are being listened to and they are being involved but may not necessarily get their way*". '*Effective communication*' and '*engagement of stakeholders*' were identified as solutions to '*lack of extensive client participation* (SMC6)'. These views are also supported in literature. For example, Cuppen *et al*., (2016) in the areas of 'public engagement' and 'project management' have suggested the need for continuously monitoring of external stakeholders throughout the course of the project.

LIMITATIONS

While the study makes several contributions to stakeholder management theory and practice, a number of limitations of the research need to be acknowledged. Firstly, this study was purely preliminarily in nature. Therefore the relationship between sector specific engagement of external stakeholders and their effects on project outcomes could not be established. Secondly, the sample covered was small hence further analysis of such relations could not be conducted. Thirdly, the study was conducted among project management practitioners in South Australia and specifically construction projects. Their opinions may thus differ from their counterparts in other regions of the world and industries. However, despite that limitation, the findings represent a snapshot engagement strategies and challenges of the affecting the external stakeholders in adopting SMA.

CONCLUSION AND RECOMMENDATIONS

Through a questionnaire survey and a series of interviews, this study investigated the perception of project management professionals on the engagement strategies and challenges associated with adopting stakeholder management approaches (SMAs) when engaging with external stakeholders in South Australia. A comprehensive literature review identified 21 engagement strategies and 9 challenges associated with adoption of SMA. The findings conclude that stakeholder identification is the most important followed a well-defined communication strategy and plan. Conflicting agendas and scare resources were found to affect the SMA adopted. A number of strategies in overcoming the challenges were suggested such as identifying stakeholders as early as the design phase of the projects. One of the main contributions lies in identifying and confirming the challenges affecting the implementation of SMA. Secondly, the extensive literature review on the stakeholder management factors as illustrated in this study, and further summarised in Table 1 confirmed the importance and significance of the 'stakeholder management approaches' within a previously underexplored South Australian context. Finally, the study contributes to the body of knowledge on SMA among project management practitioners in South Australia, an area previously under explored.

One of the notable finding was that senior management commitment and involvement were deemed as critical during the external stakeholder's engagement process. This indicates a sense of commitment thereby creating trust. Furthermore, the findings from this study extends the previous work undertaken by Yang *et al*., (2009a) and Aaltonen and Kujala (2010) which highlighted the need for further studies on stakeholder management strategies; and engaging with the stakeholders early in the project to ensure project success (Kivits 2011).

REFERENCES

Aaltonen, K and Kujala, J (2010) A project lifecycle perspective on stakeholder influence strategies in global projects. *Scandinavian Journal of Management*, **26(**4), 381-397.

Aaltonen, K, Kujala, J, Lehtonen, P and Ruuska, I (2010) A stakeholder network perspective on unexpected events and their management in international projects. *International Journal of Managing Projects in Business*, **3**(4), 564-588.

Assudani, R and Kloppenburg, T J (2010) Managing stakeholders for project management success: An emergent model of stakeholders. *Journal of General Management*, **35**(3), 67-80.

Baroudi, B and Rapp, R R (2014) Stakeholder management in disaster restoration projects. *International Journal of Disaster Resilience in the Built Environment*, **5**(2), 182-193.

Beringer, C, Jonas, D and Georg Gemünden, H (2012) Establishing project portfolio management: An exploratory analysis of the influence of internal stakeholder's interactions. *Project Management Journal*, **43**(6), 16-32.

Bourne, L (2008) Advancing theory and practice for successful implementation of stakeholder management in organisations. *International Journal of Managing Projects in Business*, **1**(4), 587-601.

Chinyio, E and Olomolaiye, P (2009) *Construction Stakeholder Management 1st Edition*. Chichester: Wiley.

Cuppen, E, Bosch-Rekveldt, M G C, Pikaar, E and Mehos, D C (2016) Stakeholder engagement in large-scale energy infrastructure projects: Revealing perspectives using Q methodology. *International Journal of Project Management*, In Press. http://dx.doi/10.1016/j.ijproman.2016.01.003

Edelenbos, J, van Buuren, A and van Schie, N (2011) Co-producing knowledge: joint knowledge production between experts, bureaucrats and stakeholders in Dutch water management projects. *Environmental Science and Policy*, **14**(6), 675-684.

Jonas, D (2010) Empowering project portfolio managers: How management involvement impacts project portfolio management performance. *International Journal of Project Management*, **28**(8), 818-831

Kivits, R A (2011) Three component stakeholder analysis. *International Journal of Multiple Research Approaches*, **5**(3), 318-333.

McGurk, B, John Sinclair, A and Diduck, A (2006) An assessment of stakeholder advisory committees in forest management: Case studies from Manitoba, Canada. *Society and Natural Resources*, **19**(9), 809-826.

Nunnally, J (1978) *Psychometric Theory: 2nd Edition*. New York, NY: McGraw-Hill.

Olander, S and Landin, A (2005) Evaluation of stakeholder influence in the implementation of construction projects. *International Journal of Project Management*, **23**(4), 321-328.

Olander, S and Landin, A (2008) A comparative study of factors affecting the external stakeholder management process. *Construction Management and Economics*, **26**(6), 553-561.

Pan, G S C (2005) Information systems project abandonment: a stakeholder analysis. *International Journal of Information Management*, **25**(2), 173-184.

Project Management Institute (2013) *A guide to the project management body of knowledge (PMBOK guide) 5th Edition*. Newtown Square, Pa: Project Management Institute.

Rhodes, S D, Bowie, D A and Hergenrather, K.C (2003) Collecting behavioural data using the worldwide web: considerations for researchers. *Journal of Epidemiology and Community Health*, **57**(1), 68-73.

Sutterfield, J S, Friday-Stroud, S S and Shivers-Blackwell, S L (2006) A case study of project and stakeholder management failures: Lessons learned. *Project Management Journal*, **37**(5), 26.

Teo, M M M and Loosemore, M (2010) Community-based protest against construction projects: The social determinants of protest movement continuity. *International Journal of Managing Projects in Business*, **3**(2), 131-144.

Vaagaasar, A L (2011) Development of relationships and relationship competencies in complex projects. *International Journal of Managing Projects in Business*, **4** (2), 294-307.

Yang, J, Shen, Q and Ho, M (2009a) An overview of previous studies in stakeholder management and its implications for the construction industry. *Journal of Facilities Management*, **7**(2), 159-159.

Yang, J, Shen, G Q, Ho, M, Drew, D S and Chan, A P C (2009b) Exploring critical success factors for stakeholder management in construction projects. *Journal of Civil Engineering and Management*, **15** (4), 337-348.

Zou, P X W, Zhang, G and Wang, J (2007) Understanding the key risks in construction projects in China. *International Journal of Project Management*, **25**(6), 601-614.

FUNCTIONAL CONSEQUENCES OF TRUST IN THE CONSTRUCTION SUPPLY CHAIN: A MULTI-DIMENSIONAL VIEW

Emmanuel Manu,[1] Nii Ankrah,[2] Ezekiel A Chinyio[3] and David Proverbs[4]

[1] *Department of Construction Management, School of Architecture, Design and the Built Environment, Nottingham Trent University, Burton Street Campus, Nottingham, Nottinghamshire, NG1 4BU, UK*

[2&3] *School of Architecture and Built Environment, University of Wolverhampton, Wulfruna Street, Wolverhampton, WV1 1LY, UK*

[4] *Faculty of Computing, Engineering and the Built Environment, Birmingham City University, Millennium Point, Birmingham, West Midlands, B4 7XG, UK*

Trust is often linked to the emergence of cooperative behaviours that contribute to successful project outcomes. However, some have questioned the functional relevance of trust in contractual relations, arguing that control-induced cooperation can emerge from enforcement of contracts. These mixed views are further complicated by the multi-dimensional nature of trust, as different trust dimensions could have varying functional consequences. The aim of this study was to provide some clarity on the functional consequence of trust in the project supply chain. Data was gathered through passive observations, document reviews and semi-structured interviews with supply chain parties on two case study projects in the UK. A thematic data analysis approach was used to uncover multiple perspectives on the functional consequences of trust in the supply chain. Findings revealed that the weaker dimensions of trust, which are impersonal (cognition-based and systems-based) and the stronger (relational-based) dimension of trust, all fostered beneficial behaviours in the supply chain (effective knowledge sharing and self-organising behaviours). However, additional behavioural consequences (relational flexibility and extra commitment) emerged when trust was relational in nature, implying that different trust dimensions and their associated behavioural consequences can be prioritized in the supply chain based on perceived work package risks.

Keywords: cognition-based trust, construction supply chains, relational-based trust, systems-based trust

INTRODUCTION

Inter-organisational trust has consistently been linked to different aspects of business performance. Sako (2007) argued that inter-organisational trust enhances business performance by reducing transaction costs, serving as an investment with future returns and contributing to continuous improvement and learning. Zaghloul *et al*., (2003) revealed that the absence of trust in business relationships raises the need to manage the contracting process using powerful control systems. Broadly, construction management literature has often associated trust with cooperative behaviour amongst

[1] emmanuel.manu@ntu.ac.uk

Manu, E, Ankrah, N, Chinyio, E A and Proverbs, D (2016) Functional Consequences of Trust in the Construction Supply Chain: A Multi-Dimensional View. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 883-892.

project parties and consequently successful project performance (see Kadefors 2004, Eriksson *et al*., 2007, Hartmann *et al*., 2010; Laan *et al*., 2011). However, this relationship between trust and performance has often been mixed, inconsistent and contradictory (Guinot *et al*. 2013, Jiang *et al*., 2015). Aubert and Kelsey (2000) revealed that in the operation of virtual teams, effective team performance was independent of trust formation. Researchers like Cox *et al*., (1997) have similarly questioned the relevance of trust in contractual relations given its fragile nature, particularly in construction. They have argued that cooperation can emerge from other interventionist equivalents of trust such as 'control' through the exercise of power and authority. These mixed views, coupled with the argument by Laan (2009), that trust issues in construction are often conceptually discussed but rarely empirically explored, therefore underscores the need for further empirical investigation. The aim of this study was to investigate the functional implications of trust in the project supply chain assembled to deliver projects. Whilst the project supply chain is complex and multi-layered, this study only focused on the supply chain relationship between main contractors and first-tier subcontractors. The sections that follow examine the nature of trust, the research methodology adopted, the research findings and discussions, based on which conclusions are then drawn.

TRUST PRODUCTION AND THE NATURE OF TRUST

The elusive nature of trust has contributed to the emergence of numerous definitions. The definition that features most prominently in literature is that trust is "a psychological state that enables a party to accept vulnerability based on positive expectations in the intentions or behaviours of other parties" (Rousseau *et al*., 1998, Dekker 2004). Rousseau *et al*., (1998) described trust as a complex multi-faceted and 'meso' concept that integrates micro-level psychological and sociological processes with macro-level institutional arrangements. This 'meso' nature of trust suggests that psychological and sociological processes, together with other contextual or institutional arrangements, would have to be taken into account when investigating the modes of trust production (Bachmann *et al*., 2011). Three modes of trust production, which reflect this 'meso' nature of trust, have consistently emerged in the literature as cognition-based trust, systems-based trust and relational-based trust.

Cognition-based trust, which is sometimes referred to as knowledge-based trust, is the primary origin of trust in inter-organisational relationships (Kadefors *et al*., 2007). Trust at this level is impersonal and devoid of previous relational experience (Kadefors *et al*., 2007). It is rational and knowledge driven (Johnson *et al*., 2005, Kadefors *et al*., 2007, Wong *et al*., 2008). As such, it derives from the assessment of a trustee's trustworthiness by obtaining and reflectively interpreting information about their credibility, reputation and competencies (Rousseau *et al*., 1998). It is founded on an assessment of the likelihood that a party will act in a self-interested manner, given the extent of interdependency, short-term gains and future exchange prospects (Kadefors *et al*., 2007). Poppo *et al*., (2015) argued that the acquisition of credible trustee information, deterrence mechanisms, potential benefits and losses, are all foundational to that willingness to accept vulnerability in exchange relationships. This dimension of trust is however subject to issues such as bounded rationality and information asymmetry (Kahneman 2003). This makes cognition-based trust relatively fragile and as such, has been described as 'thin or weak trust' (Kadefors *et al*., 2007, Ngowi 2007).

System-based or institutional-based trust is that which derives from contextual characteristics like the contractual agreements, contracting environment, cultural and societal norms as well as what is known to constitute ethical behaviour in a given business environment i.e. norms of practice (Dekker 2004, Kadefors *et al*., 2007). Laan *et al*., (2011) echoed somewhat similar views by linking systems-based trust to extrinsic factors such as formal contractual rules and monitoring processes. Wong *et al*., (2008) has argued that communication systems, contracts and agreements, organisational policy and the establishment of joint ethos, are all sources of system-based trust in construction contracting. Kadefors *et al*., (2007) further describes system-based trust as 'semi-strong trust' given that it still incorporates cognition-based trust but can still be impersonal and devoid of any prior relationship or exchange. Broadly, this dimension of trust is founded on the establishment of a contracting environment that reduces the potential for opportunism; thereby increasing the trustor's ability to be trustful.

Relational-based trust is that which derives from repeated interactions and exchanges that evolve as inter-organisational relationships are projected into the future. In this instance, information about a party's trustworthiness already becomes implicit in the relationship (Rousseau *et al*., 1998). This dimension of trust is synonymous with affect-based trust (Johnson *et al*., 2005, Wong *et al*., 2008), which originates from the emotional bonding and thoughtfulness that exists between trustor and trustee (Cheung *et al*., 2011). Johnson *et al*., (2005) argued that trust at this level is characterized by feelings of security and perceived relationship strength that emerges as emotional connections deepen. This form of trust has been described as 'thick' or 'strong' trust (Murphy 2006, Kadefors *et al*., 2007), given that it is rooted in interpersonal relationships that have evolved over a considerable period of time. This relational-based dimension of trust reflects the meso-level trust (Rousseau *et al*., 1998), which integrates both cognition and systems-based dimensions of trust, as well as that which derives from repeated social interactions. Hence, its development requires a combination of cognitive, emotive, and communicative factors (Murphy 2006). Zaheer *et al*., (2005) has also linked relational-based trust to the opportunity for reciprocation. The time element (repeated social interactions) that is needed for relational based trust to evolve implies that there can be that preparedness to defer reciprocation of trust to a future exchange. It is thus linked to the demonstration of goodwill - bounded by empathy, dedication and openness (Ireland *et al*., 2007).

This three dimensional view of trust is centred on the manner in which trust evolves in inter-organisational relationships and the nature of trust that will exist, depending on the state of the relationship. Given this three-dimensional view, there is the opportunity to probe further into the functional consequences of trust during projects. The performance benefits of trust could be narrowed down to the functional consequences that these three trust dimensions present during inter-organisational exchanges. In most instances, trust is used within the context of the relational-based dimension that exists when relationships have evolved over a considerable period of time. However, for any inter-organisational exchange where trust is considered to be absent or minimal, there is arguably a degree of trust although this could be of a more cognitive and weaker nature. Such cognition-based dimensions of trust could still be sufficient for achieving desirable outcomes depending on the transaction circumstance. Yet in the literature, the attribution of performance benefits to trust only seems to be broadly directed towards the stronger relational-based dimension (see

Doloi 2009, Smyth *et al*., 2010). This highlights the need to examine the influence of these distinct dimensions of trust.

METHODOLOGY

A multiple case study approach was adopted as part of a larger study on trust in the construction supply chain. The case study approach was employed because of the proximity to reality that it allows (Flyvbjerg 2006) when studying complex concepts and the ability to triangulate multiple sources of evidence (Proverbs *et al*., 2008). The research drew on the interpretivist epistemology. This enabled knowledge on trust and its functional consequences to emerge from interpretation of multiple realities from the different parties (main contractors and subcontractors) working together on live projects. Whilst four case studies were conducted, only the two case studies summarised in Table 1 are being reported here due to space constraints.

Table 1: Background details of case study projects

	Nature of project	Nature of works	Client type	Contractor selection	Procurement route & contract form	Project duration and status	Contract sum	Number of sub-contractors
Case A	Offices	Refurbishment and new-build	Public client	Competitive tendering	Design & build with NEC3 contracts	15 months with 55% complete at Month 9	£ 30.5 million	29
Case B	School	Refurbishment and new-build	Public client	Negotiation	Framework agreement with NEC3 contracts	12 months with 65% complete at month 8	£ 2 million	30

These projects varied in size, and had been procured through different routes, all of which could have an influence on the main contractor's approach to subcontractor selection. The unit of analysis in each of the cases was the project supply chain. Data was gathered through semi-structured interviews, non-participant observations (site meetings and pre-start meetings) and document reviews. In total, 16 in-depth interviews were conducted face-to-face with main contractor and subcontractor personnel across the two projects, with each interview lasting approximately 60 minutes. Interview transcripts, word-processed observation notes and documentation were integrated onto a single platform using the qualitative data analysis software QSR Nvivo. The three-pronged qualitative data analysis strategy proposed by Miles and Huberman (1994) - data reduction, data display and conclusion drawing or verification - was used to undertake thematic analysis of the data. The thematic analysis process was also influenced by the three dimensional view of trust as uncovered in the literature.

For example, Wong *et al*., (2008) suggested in their trust framework that knowledge, communication and interactions are paramount for the development of cognition-based trust on projects. This dimension of trust was also suggested to be more related to development of confidence in a party's competence (Johnson *et al*., 2005). As such, when confidence in the project supply chain derived from the reflexive process of knowledge acquisition and interpretation, it was ultimately abstracted as cognition-based trust during the analysis (see example in Table 2 and thematic analysis output in Figure 1).

Four behavioural consequences emerged from the analytical process as self-organising behaviour, effective knowledge sharing, extra commitment and relational flexibility. A thematic analysis was then undertaken using the matrix coding query function in QSR Nvivo. The first query mapped the 'nature of trust' against the 'behavioural consequences'.

Table 2: Example of transcript extracts showing coding and data reduction process

Extracts from transcripts	Coding and abstraction
"…we'll meet them, sit down with them, get the drawings, package is out, discuss the package and get an idea, a gut feeling, on the people that you're dealing with at that point and how they kind of come across to you…so it is your gut feeling and your confidence of what they do" – Project QS, Case A	gut feeling → cognition-based trust → nature of trust
"…that subcontractor worked with [main contractor A] a number of times before, knows exactly what we do, our procedures, and what to expect so they really synergise with our own procedures and policies" – Project QS, Case A	previous impersonal experience with firm → existence of joint ethos → system-based trust → nature of trust
"I know nearly all their site managers, I know nearly all the surveyors, I know the managing director, I know the managing quantity surveyor as well, I've got awards from them, health and safety awards in the past as well, on two occasions. So I know them quite well and you get sort of a confidence with them. When you do a job with them you are confident that the job is going to go ok because of the site staff" – Brickwork subcontractor, Case B	Previous interpersonal experience → relational-based trust → nature of trust

The second query mapped the 'behavioural consequences' against the project supply chain, which was an attribute of the data. These queries enabled the exploration of emergent patterns across the data. The resulting thematic analysis output is illustrated in Figure 1.

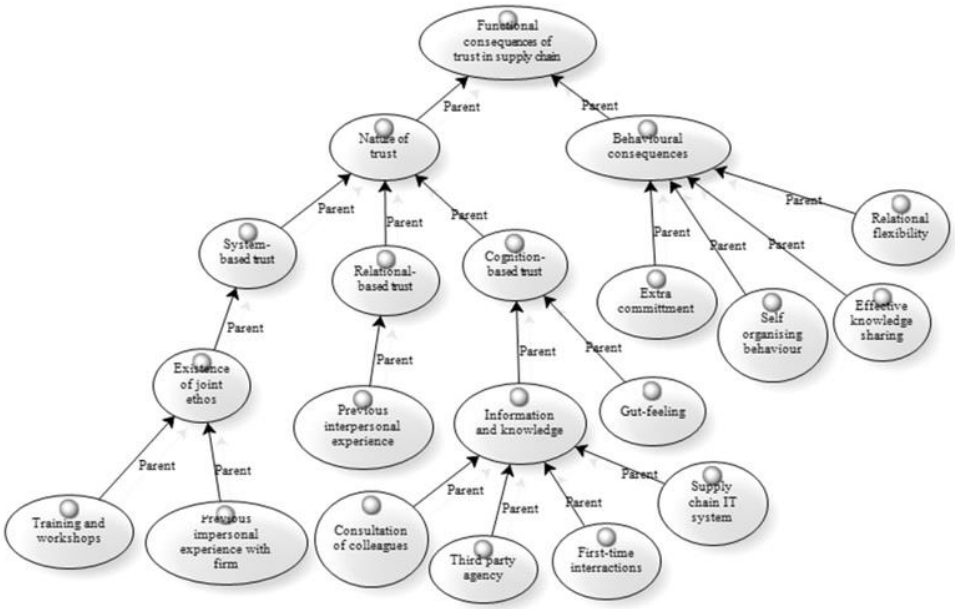


Figure 1: Thematic analysis output on the functional consequences of trust in the supply chain

FINDINGS AND DISCUSSION

All the three trust dimensions of trust were revealed to have promoted effective knowledge sharing and self-organising behaviours across the two case study projects

(see Table 3 and 4). When trust was cognition-based and subcontractors were being used for the first time, they were keen to perform on the project so as to affirm their competence with the main contractor's project team. The roofing subcontractor on Case A for instance, had been vetted as a good performer but was unproven to neither the main contractor nor their project team. This subcontractor had been carefully vetted by obtaining considerable information during supply chain assessments, pre-order and pre-start meetings.

During the project, this roofing subcontractor self-managed their work package satisfactorily and contributed as much as other regular subcontractors when it came to proposing value engineering solutions and sharing valuable knowledge that helped to improve project outcomes. In their view, a good performance with this first work opportunity was foundational to building a long-term business relationship with the main contractor. These two behaviours (effective knowledge and self-organising behaviours) were also detected when trust was of a systems-based and relational-based nature. Despite the project team's confidence and vulnerability acceptance in respect of the roofing subcontractor on Case A (cognition-based trust), relational flexibility, as a behavioural consequence of trust, was absent.

Table 3: Trust between main contractor and subcontractors in Case A

Subcontractors	Cognition-based trust	System-based trust	Relational-based trust	Manifested Behaviours
Panelling subcontractor	✓	✓	✓	EKS, SO, EC, RF
Tiling/mosaic subcontractor	✓	✓	✓	EKS, SO, EC, RF
M&E services contractor	✓	✓	✓	EKS, SO, EC, RF
Scaffolding subcontractor	✓	✓	✓	EKS, SO, EC, RF
Carpentry/Joinery Subcontractor	✓	✓	✓	EKS, SO, EC, RF
Roofing Subcontractor	✓	✘	✘	EKS, SO

EKS – Effective knowledge sharing, SO – Self organisation, EC - Extra commitment, RF-Relational flexibility

Table 4: Trust between main contractor and subcontractors in Case B

Subcontractors	Cognition-based trust	System-based trust	Relational-based trust	Manifested Behaviours
Roofing Subcontractor	✓	✓	✘	EKS, SO
Bricklaying Subcontractor	✓	✓	✓	EKS, SO, EC, RF
Interior Works Subcontractor	✓	✓	✓	EKS, SO, EC, RF
Electrical Subcontractor	✓	✓	✘	EKS, SO

EKS – Effective knowledge sharing, SO – Self organisation, EC - Extra commitment, RF-Relational flexibility

As such, governance remained predominantly formal and in compliance with contractual provisions. Similar patterns of contractual governance were also detected

when trust derived from the embeddedness of subcontractors in the main contractor's way of working (system-based trust).

This was exemplified by the roofing subcontractor on Case B (see Table 4). This roofing subcontractor's site management personnel had completed an in-house health and safety (H&S) training and certification with the main contractor. As such, the main contractor's project team exhibited considerable confidence in the ability of the roofing subcontractor to uphold safety standards on site (system-based trust). They were even exempted from lengthy H&S inductions during the project. This confidence existed despite the absence of any previous working relationship between the project team and the subcontractor (impersonal). Nonetheless, relational flexibility was still absent due to the impersonal nature of the relationship.

Relational flexibility and the display of extra commitment by going an extra mile, were however distinctively linked with the existence of relational-based trust in the project supply chain. Subcontractors were prepared to make more sacrifices and accept higher vulnerabilities by considering the 'bigger picture' of future reciprocation opportunities that could accrue from their trusting behaviours. Beyond their contractual obligations on the project, subcontractors across the two cases that had a long-standing relationship with the main contractor's team had provided tendering assistance through early involvement, worked weekends on normal rates to get programme back on track and made pre and post-tender design inputs. The scaffolding contractor on Case A went as far as continuously progressing with changes based on mere verbal instructions so as to avoid delays to the project. They had a positive psychological expectation that even if they were not fully reimbursed for these changes, the favour will be reciprocated on a future exchange - relational based trust.

Relational flexibility, as a behavioural consequence, also made it possible for governance to be less formal and relaxed. It is this functional consequence that reduced the transaction costs associated with managing the project supply chain. This was clearly depicted by the electrical subcontractor on Case B. This was a subcontractor that previously had a long-standing supply chain relationship with the main contractor and their project teams. However, having not secured any work for a considerable period of time, this repeated relationship and consequently relational-based trust was destroyed. The main contractor came to the realisation that the relationship with a good and helpful subcontractor had become strained, and hence offered them an opportunity on this new project in an attempt to repair the broken-down trust. However, relational-based trust was only just under repair but still non-existent. The subcontractor revealed their difficulty in accepting any vulnerabilities that were underpinned by future reciprocation opportunities with the main contractor or their project team as clearly captured below:

> So, whereas before, if something small needed to be done and we'd just say 'oh, we'll do that.' Now, it's like...'it's a cost.'…So they've broken the supply chain friendship in a way - Electrical subcontractor, Case B

The above statement reveals how contractual the supply chain relationship had become in the absence of relational-based trust. Extra commitment and relational flexibility were now absent as behavioural consequences due to this absence of relational-based trust. Previous studies have revealed similar links between inter-organisational trust and strategic relational flexibility in supply chain networks (see Wathne *et al*., 2004). However, whilst most of these studies acknowledge the multi-dimensional nature of trust, the relationship between trust and performance is often analysed in a composite manner. This present study has revealed that it is rather the

relational dimension of trust that gives rise to relational flexibility, which consequently reduces transaction costs of projects. This relational dimension of trust and consequently relational flexibility, increases the relevance of social capital as a social form of contract for governing more complex transactions during a project. This is also consistent with the findings by Moore *et al*., (2016), who argued that existing social capital minimizes the negative relationship between project complexity and project performance. In effect, this social contract increases operational flexibility beyond that which is explicitly specified in the written contracts. This further places into perspective, previous links between trust and performance of projects (see Zaghloul *et al*., 2003). Zaghloul *et al*., (2003) revealed that trust-based relationships reduce transaction costs of projects through less reliance on formal contractual provisions. However, the discourse on trust and performance should be narrowed down to these influences of the different trust dimensions.

The above findings support the assertion that dependence on strong trust that is developed through repeated face-to-face interactions (relational-based) is not necessarily a pre-requisite for project success. Other dimensions of trust also give rise to some beneficial behavioural consequences that can be adequate for achieving success, particularly when work packages are less complicated (less complex, risky and critical tasks). According to Meyerson *et al*., (1996), swift sources of trust that are impersonal, are required for one-off transactions where time and energy (resources) cannot be devoted to building trust-based relationships through repeated face-to-face contacts over a considerable period. For such work packages, behaviours that derive from the impersonal cognition and system-based trust (self-organising behaviour and effective knowledge sharing) can just be enough for achieving success. However, a caveat is that even the weaker cognition-based dimension of trust does not emerge automatically. The main contractors in this study had implemented a rigorous supply chain vetting process based on which considerable information on subcontractor performance was acquired and analysed, particularly when trust was impersonal. It is therefore prudent that project teams understand the risk profiles of their work packages so as to gauge the priority that is placed on relational-based trust and its behavioural consequences.

CONCLUSIONS

This study represents an attempt to isolate and analyse the performance effect of the different trust dimensions in the project supply chain. The analysis has revealed how different trust dimensions varyingly influence behaviour of the project supply chain. Beyond the behavioural consequences that are promoted in the presence of all three trust dimensions (self-organising behaviour and effective knowledge sharing), there are additional behavioural consequences that emerge when trust is relational in nature (extra commitment and relational flexibility). It is these additional behaviours that allow for relational forms of governance to manifest and become beneficial by reducing transaction costs during a project. The relationship between trust and performance is thus contingent on other factors. As such, different dimensions of trust and their associated behavioural consequences can be prioritized and promoted in the project supply chain based on perceived work package risks. Reconsideration should therefore be given to the over-emphasis on relationally derived trust as the only pre-requisite for fostering positive behaviours and project success. These findings and conclusions are however not without limitations. They cannot be generalised beyond the cases that were studied and only focused on the dyadic relationship between main

contractors and first-tier subcontractors despite the complex multi-layered nature of the project supply chain.

REFERENCES

Aubert, B A and Kelsey, B L (2000) *The Illusion Of Trust And Performance*, CIRANO Working Papers, Centre for Interuniversity Research and Analysis on Organisations, Montreal, Canada.

Bachmann, R and Inkpen, A C (2011) Understanding institutional-based trust building processes in inter-organizational relationships. *Organization Studies*, **32**(2), 281-301.

Carson, S J, Madhok, A, Varman, R and John, G (2003) Information processing moderators of the effectiveness of trust-based governance in interfirm R&D collaboration. *Organization Science*, **14**(1), 45-56.

Cheung, S O, Wong, W K, Yiu, T W and Pang, H Y (2011) Developing a trust inventory for construction contracting. *International Journal of Project Management*, **29**(2), 184-96.

Cox, A and Thompson, I (1997) Fit for purpose contractual relations: Determining a theoretical framework for construction projects. *European Journal of Purchasing & Supply Management*, **3**(3), 127-35.

Dekker, H (2004) Control of inter-organizational relationships: Evidence on appropriation concerns and coordination requirements. *Accounting, Organizations and Society*, **29**(1), 27-49.

Doloi, H (2009) Relational partnerships: The importance of communication, trust and confidence and joint risk management in achieving project success. *Construction Management and Economics*, **27**(11), 1099-109.

Eriksson, P E and Laan, A (2007) Procurement effects on trust and control in client-contractor relationships. *Engineering, Construction and Architectural Management*, **14**(4), 387-99.

Flyvbjerg, B (2006) Five misunderstandings about case-study research. *Qualitative inquiry*, **12**(2), 219-45.

Guinot, J, Chiva, R and Mallén, F (2013) Organizational trust and performance: Is organizational learning capability a missing link? *Journal of Management & Organization*, **19**(05), 559-582.

Hartmann, A and Caerteling, J (2010) Subcontractor procurement in construction: The interplay of price and trust. *Supply Chain Management: An International Journal*, **15**(5), 354-62.

Ireland, R and Webb, J (2007) A multi-theoretic perspective on trust and power in strategic supply chains. *Journal of Operations Management*, **25**(2), 482-97.

Jiang, X, Jiang, F, Cai, X and Liu, H (2015) How does trust affect alliance performance? The mediating role of resource sharing. *Industrial Marketing Management*, **45**, 128-38.

Johnson, D and Grayson, K (2005) Cognitive and affective trust in service relationships. *Journal of Business Research*, **58**(4), 500-507.

Kadefors, A (2004) Trust in project relationships: Inside the black box. *International Journal of Project Management*, **22**(3), 175-182.

Kadefors, A and Laan, A (2007) Modes of trust production in project-based industries. *In*: B Atkin and J Borgbrant (Eds.) *Proceedings of the 4th Nordic Conference on Construction Economics and Organisation*. Lunea: University of Technology, Sweden, 47-58.

Kahneman, D (2003) Maps of bounded rationality: Psychology for behavioral economics. *The American Economic Review*, **93**(5), 1449-1475.

Laan, A, Noorderhaven, N, Voordijk, H and Dewulf, G (2011) Building trust in construction partnering projects: An exploratory case-study. *Journal of Purchasing and Supply Management*, **17**(2), 98-108.

Laan, A T (2009) *Building Trust: The Case of the Construction Industry*. PhD Thesis, University of Twente.

Meyerson, D, Weick, K E and Kramer, R M (1996) Swift trust and temporary groups. *In*: R M Kramer and T R Tyler (Eds.) *Trust in organizations: Frontiers of theory and research*. Thousand Oaks, CA: Sage Publications, 166-95.

Moore, C B, Payne, G T, Autry, C W and Griffis, S E (2016) Project complexity and bonding social capital in network organizations. *Group & Organization Management*, 1059601116650556.

Murphy, J (2006) Building trust in economic space. *Progress in Human Geography*, **30**(4), 427.

Ngowi, A (2007) The role of trustworthiness in the formation and governance of construction alliances. *Building and Environment*, **42**(4), 1828-35.

Poppo, L, Zhou, K Z and Li, J J (2015) When can you trust "trust"? Calculative trust, relational trust, and supplier performance. *Strategic Management Journal*, **37**(4), 724-741.

Proverbs, D and Gameson, R (2008) Case study research. *In*: A Knight and L Ruddock (Eds.) Advanced research methods in the built environment, pp. 99-110. Chichester, UK: John Wiley & Sons.

Rousseau, D M, Sitkin, S B, Burt, R S and Camerer, C (1998) Not so different after all: A cross-discipline view of trust. *Academy of Management Review*, **23**(3), 393-404.

Sako, M (2007) Does trust improve business performance? *In*: R M Kramer (Ed.) *Organizational trust: A reader*. USA: Oxford University Press

Smyth, H, Gustafsson, M and Ganskau, E (2010) The value of trust in project business. *International Journal of Project Management*, **28**(2), 117-29.

Wathne, K H and Heide, J B (2004) Relationship governance in a supply chain network. *Journal of Marketing*, **68**(1), 73-89.

Wong, W K, Cheung, S O, Yiu, T W and Pang, H Y (2008) A framework for trust in construction contracting. *International Journal of Project Management*, **26**(8), 821-9.

Zaghloul, R and Hartman, F (2003) Construction contracts: The cost of mistrust. *International Journal of Project Management*, **21**(6), 419-24.

Zaheer, A and Harris, J (2005) Interorganizational trust. *In*: O Shenkar and J J Reuer (Eds.) *Handbook of Strategic Alliances*. Thousand Oaks, CA: Sage Publications, 169-97.

COLLABORATIVE TRUST IN UK FURTHER EDUCATION (FE) PROCUREMENT STRATEGIES

Jason Challender[1], Peter Farrell[2] and Fred Sherratt[3]

[1] *Leeds City College, Park Lane Campus, Park Lane, Leeds LS3 1AA, UK*

[2] *School of Engineering, University of Bolton, Deane Road, Bolton., BL3 5AB, UK*

[3] *Engineering and the Built Environment, Anglia Ruskin University, Bishop Hall Lane, Chelmsford, Essex, CM1 1SQ, UK.*

This study aims to explore the trust building mechanisms in collaborative procurement of successful UK FE projects. A review of literature identifies a framework for measuring the degree of trust through established trust-related attributes and behaviours. A mixed methods approach is adopted within a sample drawn from contracting, consulting and client organisations that have had experience of collaboratively procured FE projects. Key findings indicate that certain trust building mechanisms including workshops, financial incentives and CPD are particularly effective at developing trust. Notwithstanding this, there are barriers which include the short term nature of construction contracting which suggests strategic rather than project partnering may be more effective. Quantitative study findings have determined that there is a Pearson's Product Moment correlation coefficient of 0.87 between all trust building mechanisms and trust generated. Based on a p value of ≤ 0.05 it suggests a very strong influence between the two variables. Cronbach's Alpha test results revealed good reliability based on a coefficient of 0.79. The study gives an understanding of how effective trust building mechanisms can be implemented, possibly through an appropriately designed toolkit for improving project outcomes. In consideration of this fresh insight future research beyond the FE sector is recommended as an extension to this study.

Keywords: collaboration, integration, procurement, partnering, trust

INTRODUCTION AND BACKGROUND TO RESEARCH

Over recent years, the Further Education (FE) sector has largely focused on increasing partnering strategies for collaborative procurement of major capital projects. Such initiatives are often heralded as vehicles to obtain best value, improve levels of quality and optimise service delivery. Yet there is still evidence of low levels of client satisfaction, owing mostly to poor cost and time predictability, which have in turn been attributed to low level of trust in practice (Chow *et al*., 2012). This potential lack of trust in collaborative working practices could possibly explain the downward trend in favour of more market-based approaches to construction procurement (Ross, 2011).

In previous studies of collaborative working, very little attention has been focused on the trust building process, the main emphasis of research focusing on the trustworthiness of science rather than interpersonal collaborative trust (Harris and Lyon, 2013). Thorgren *et al*., (2011) also argued that "scant attention has been paid to

[1] jason.challender@leedscitycollege.ac.uk

Challender, J, Farrell, P and Sherratt, F (2016) Collaborative Trust In UK Further Education (FE) Procurement Strategies. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 893-902.

the role and development of trust in partner alliances". The study therefore seeks to fill this gap in knowledge by examining trust building attributes and mechanisms, and exploring the influence of these on generating trust in construction partnering. It has also been designed to address calls for greater insight into how trust is created, mobilised and developed (Huemer, 2004) and for more understanding of the effects and impact of other factors interacting with trust (Huang and Wilkinson, 2013).

Much has been written on trust as a collaborative necessity (Chan *et al*., 2004, 230) and this has largely focused on the advantages and merits of collaborative working and practice. However, very little has been written on the trust building process and how to create the trust within partnering relationships through trust building mechanisms. This gap in knowledge is important given that "trust appears to be a stranger in construction contracting where confrontation remains the prevalent environment" (Wong *et al*., 2008). To address the aforementioned deficiency and dilemma, this study seeks to focus 'upstream' on those constructs, attributes, factors, mechanisms and initiatives which could build trust in the context of partnering practices. It identifies and evaluates trust 'generators', which the study refers to as 'trust building mechanisms', and 'inhibitors' or barriers in this respect. This is designed to facilitate greater understanding of how trust building initiatives can be designed and implemented in developing a framework for improving public sector procurement strategies, specifically in the FE sector. The research question focuses on whether trust building mechanisms influence the quality of trust in partnering arrangements. This is a particularly important question as generating addition trust could have a positive effect on increasing collaboration and therein improving overall project outcomes.

The research questions are two-fold; to examine which trust-building mechanisms can be used in construction (specifically in FE), and thereafter, which are more successful than others when implementing trust building strategies.

Review of Literature

Trust building mechanisms

This study has identified previous research relating to the influence of key critical factors on improving trust in UK collaborative procurement strategies, and refers to these as 'trust building mechanisms'. Despite this, very little has been written on how these same factors and mechanisms can influence trust, especially in partnering arrangements. Such success factors for influencing construction performance have included motivational measures by way of financial pain-share, gain-share initiatives (Tyler and Blader, 2003). Furthermore Beach *et al*., (2005, 611-621) advocated regular motivational based performance reviews through workshops to promote corrective action. These could form part of innovative motivational initiatives which seek to pool ideas, transfer knowledge, allow open communication and capture feedback. Lessons learnt as part of this process could ensure alignment to aims, visions and the spirit of the partnering arrangement. The permeability and conduct of organisations have been found to be an important ethical factor and these include fairness, equality, governance and regulation (Wong *et al*., 2008). Organisational-based factors are also considered important through alignment of corporate strategies and relationships designed to achieve mutual objectives and benefits between contracting organisations (Silva *et al*., 2012). Other organisational factors on a practical level could include jointly compatible management systems and process for sharing information (Beach *et al*., 2005, 611-621). These factors have been framed

into trust building mechanisms which formed the basis of the study and these are included in Table 1, with references included. They have influenced the basket of questions used as part of the data collection tool in identifying the underlying factors that influence trust generation and development, and framing these into a partnering context.

Table 1: Trust building mechanisms identified from literature review

Trust Building Mechanisms	Literature Source	Observation, Proposition or Explanation
Workshops and review meetings	Beach *et al*., 2005	Partnering workshops designed to reduce conflicts and problems
Social functions	Cheung *et al*., 2011	Promotes right environment for bonding and aids relational development between teams
Incentive pain/share schemes	Tyler and Blader 2003	Rewarding performance can raise morale
Open communication strategies	Beach *et al*., 2005	Promotes alternative forms of engagement
Styles of leadership	Pinto *et al*., 2009	Democratic styles can increase morale
Partnering charters	Chan *et al*., 2004	Aligns partnering visions
Fair and equitable contract terms	Wong *et al*., 2008	Promotes sense of fairness and avoids mismatch of effort and reward
CPD, teaching and learning	Chow *et al*., 2012	Can improve cooperative behaviours
Professional recognition	RICS 2003	Can enhance reputations and confidence
Transparent joint accounting policies	Wong *et al*., 2008	Open book accounting can increase sense of fairness
Senior management commitment to decision making	Cheung *et al*., 2011	Can lead to decision making
Compatibility/complimentary management systems	Silva *et al*., 2012	Can facilitate improved ways of sharing and processing information between firms
Issue resolution processes	Pinto *et al*., 2009	Avoids disputes arising and facilitates escalation procedures

RESEARCH METHODS

Research design; procedure and design of data collection tool

As referred to in the introduction, the research questions are to examine which trust-building mechanisms can be used in construction (specifically in FE), and thereafter, which are more successful than other as part of trust building strategies. These underpin the study aim to explore trust building mechanisms in collaborative procurement of successful UK FE projects. A mixed method approach using both quantitative and qualitative methodologies was adopted for the study to triangulate data collection with the aim of increasing validity of its findings (Amaratunga *et al*., 2002, 19-21). Initial qualitative enquires were conducted to refine the research problem through consultation with experienced practitioners. For the quantitative approach, previous studies were adapted in the research design to provide an authoritative tool and evaluation framework for the measurement of trust using survey questionnaires. A pilot study was undertaken which highlighted some potentially unreliable questions which were modified accordingly for the main study. The main quantitative survey was administered electronically with 79 replies received which represented an overall response rate of 63.20%. Data sourced in this way was from four different group categories of participants, namely construction clients,

consultants, main contractors and subcontractors. Samples of participants have been selected from individuals and organisations that have gained sufficient knowledge and experience of collaboratively procured construction projects in the FE sector.

Survey questionnaires were designed to measure participants' levels of agreement and disagreement with a basket of statements, as advocated by Hoxley (2008), and utilising a six point Likert multi-item scale of 0 to 5. Such statements were based on lists of attributes which were developed for each respective group of the measured independent and dependent variables (Chow *et al*., 2012; Cheung *et al*., 2011, 184-196). These measured the extent of trust building mechanisms employed on partnering projects as the independent variable (IV) and the quality and extent of trust as the dependent variable (DV). The foundations for such trust building mechanisms were previously referred to in the review of literature. Participants were asked to relate these statements to their last partnering project in terms of the level of their agreement/disagreement. Unfortunately, owing to the restrictions of this paper it was not possible to include all statements but examples for measuring the IV and DV are given in Table 2 and Table 3 respectively. There were 18 statements for measuring the IV and 31 statements for measuring the DV, in this regard, and these were adapted from several previous similar studies (Pinto *et al*., 2009; Cheung *et al*., 2011; Wong *et al*., 2008; Chow *et al*., 2012). This was a concerted effort to improve the validity and reliability of the study by providing an authoritative measurement tool and evaluation framework for trust. Statistical treatment of the data was then carried out to take account to substitute unsure for the mean of the participants' scores of the variable being measured, as advocated by Kalla (2009). Data was then subjecting to correlation analysis, with the significance or 'p' value set at ≤ 0.05, to determine the Pearson's Product coefficient and whether trust building strategies have an influence on the quality of trust in partnering arrangements. Survey questions also were designed to obtain subject variable data from the participants relating to their last partnering project alongside demographic information and profiles of participants and their organisations.

The qualitative approach consisted of eight interviews, with data sourced from construction clients, consultants, main contractors and subcontractors. Samples of participants were, like those of the quantitative approach, purposively selected from individuals and organisations that have gained sufficient knowledge and experience of collaboratively procured construction projects in the FE sector. Codes were developed from word count as part of content analysis from the raw data transcripts. These were formulated from frequently occurring words and then grouped under theme headings. Questions revolved around whether trust building mechanisms do actually influence the quality of trust in partnering. By way of examples, one question specifically asked participants which trust building mechanisms they believed were most and least effective, whilst another asked participants for their views around the quantitative analysis findings.

A manual system of coding attaching key words or tags to segments of text and content analysis counting frequencies, sequences or locations of words or phrases was utilised. These were sourced from the raw data interview transcripts and summarized in tables with codes and themes listed. In total there were a total of 31 main qualitative codes and examples included 'teamwork', 'availability of resources' and 'working to common goals'. Examples of themes included 'best practice', 'factors that instil trust' and 'potential barriers'.

Table 2: Examples of statements/ indicators to measure trust building mechanisms (independent variable) (adapted from Pinto et al., 2009; Cheung et al., 2011; Wong et al., 2008; Chow et al., 2012). Likert scale of 0-5

Question no.	ID	Attributes of motivational, organisational and ethical-based trust building mechanisms	Statements / Indicators
Q1	Mechanism1	Workshops and review meetings	Partners fulfilled their obligations without frequent reminders
Q2	Mechanism2	Social functions/network events	Partners performed and behaved in a consistent way towards their counterparts at all times
Q3	Mechanism3	Introduction of incentivisation scheme	Performance related 'gain share/pain share' partnering initiatives were exercised
Q4	Mechanism4	Open communications strategies	There were frequent newsletters and e-mail updates designed to keep all staff fully informed of project status

Table 3: Examples of statements/ indicators to measure attributes of trust behaviours/expectations (dependent variable) (adapted from Chow et al., 2012; Lu and Hao, 2013; Construction Institute, 2013; Silva et al., 2012; Black et al., 2000). Likert scale of 0-5.

Question no.	ID	Attributes of trust expectations	Statements / Indicators; behaviours and expectations
Q1	Expectation1	Reliability	Partnering workshops designed to resolve conflicts and problems were well attended at both executive and project team levels
Q2	Expectation2	Consistency	There were frequent social functions and network events arranged between the project teams
Q3	Expectation3	Respect	Project teams had faith and respect in their counterparts
Q4	Expectation4	Intuition/ Foresight	Partners created solutions to overcome potential future unforeseen problems, risks and contingencies

The table became a plan to develop a narrative for the research finding, discussion and conclusion chapters of this study. Findings of the study were developed by comparing the qualitative data from the interviews with the arguments and theories derived from the literature review. In this way, data similarities and inconsistencies were recorded between primary and secondary data sources and propositions made. It prompted interesting discussions to be developed especially where conflicting opinions were apparent. Conclusions were developed through personal reflections of the study findings and recommendations were included in areas where further research was deemed to be required.

RESEARCH FINDINGS AND DISCUSSION

Quantitative analysis: Questionnaire data

The number of participants and their varying profiles and demographic details demonstrated a diverse and wide sample representation for construction professional employed in the education sector. The majority of the subject variable data showed that most of the participants (65 out of 79) were over 35 years old. The majority held membership of professional bodies (71), possessed qualifications of degree or above

(55), gained more than 15 years' working experience (61) and were mostly employed by relatively large organisations.

The mean level of all 18 trust building mechanisms (IV), based on the six point Likert multi-item scale of 0 to 5 for participants responses, was recorded as 2.60. It represented a percentage score of 52.09%, relative to minimum (0%) and maximum levels (100%) of trust building mechanisms adopted and calculated from the questionnaire scores. This could reflect a general lack of attention or focus on introducing trust building initiatives, mechanisms or strategies into FE partnering strategies. Furthermore the mean level of all 31 trust expectations and behaviours (DV), based on the six point Likert multi-item scale of 0 to 5 for participants responses, was recorded as 2.54. It represented a percentage score of 50.83%, relative to minimum (0%) and maximum levels (100%), of overall levels of trust prevalent in college partnering arrangements and could reflect a general lack of trust in the FE sector. Although these mean scores for both the IV and DV questionnaire results were concentrated around the 50% mark and initially considered being 'middle of the road', there was in fact a reasonable spread of results across most responses and participants. Extremities of scores in this way ranged from 0 (very strongly disagree) to 5 (very strongly agree).

The measured data relating individually to the IV and the DV was of a parametric nature, based on a normal distribution. Accordingly, Pearson's Product Moment test was used to determine correlation coefficients between the IV and the DV. This revealed a correlation coefficient of 0.87 with significance set at (p) ≤ 0.05, which according to Higgins (2003) can be interpreted as representing a very strong relationship between the two variables. Cronbach's Alpha for the data was calculated at 0.79, which according to the George and Mallery (2003) is acceptable and therein supports the internal reliability of the data collection instrument. Based on the correlation coefficient of 0.87 and significance set at (p) ≤ 0.05 this has led to the null hypothesis relating to this study being rejected; there is a relationship between trust building strategies and the quality of trust in partnering arrangements. This effectively means that the employment of trust building mechanisms are determined by this study to be an influencing factor on levels of trust generated in partnering. Furthermore the quantitative analysis undertaken on subject variables reveals that both the complexity of projects and qualifications of construction professionals could have a small positive influence on trust between partners with Spearman correlation coefficients of 0.24 and 0.31 recorded respectively.

Qualitative analysis: Interview data

The main purpose of the qualitative analysis was to establish which trust building mechanisms are more important than others. Interviews with eight participants revealed contrasting opinions on most of the trust building mechanisms when examined against the literature. On reflection of the research findings, when analysed for similarities and inconsistencies, it became apparent that there were several disagreements with existing thinking. Table 4 outlines one such example and contrary to the literature identifies the importance of previous relationships and inherent lack of knowledge and commitment to trust building mechanisms.

When reflecting on which trust building mechanisms are more effective than others the qualitative analysis reveals that the following initiatives are considered to have greater influence on generating trust in partnering arrangements:

6. Facilitation of regular workshops and review meetings at both executive and project team levels, specifically designed to resolve conflicts and problems.
7. Formulation of strategies to develop mutually aligned corporate and strategic objectives between partnering organisations and to ensure that senior management are committed and involved in key decision making at various stages of projects.
8. Implementation of performance related 'gain share/pain share' partnering initiatives that are considered fair and equitable to partners alongside transparent joint 'open book' financial accounting policies for all contractor/subcontractor valuations.
9. Formulation of good internal and external communication strategies with frequent newsletters and e-mail updates designed to keep all staff fully informed of project status.
10. Strategies related to CPD of project teams, specifically linked to partnering.

Table 4: Qualitative themes and data analysis

Qualitative Themes	Literature Source	Observation, Proposition or Explanation	Data Inconsistencies	Data Similarities
Factors that instil trust in partnering arrangements. Trust building mechanisms.	Cheung *et al*., (2003). Briscoe and Dainty (2005) Thurairajah *et al*., (2006) Wong *et al*., (2007)	Shared ethos based on trust, equity and fairness between partners is essential. Levels of trust can grow if trust reciprocated between partners. Social interaction, power, identities and expectations influence the degree and quality of trust.	Trust generated from previous relationships especially at senior levels. Lack of knowledge and commitment to initiatives in some cases.	Equitable working relationships coupled dispute resolution process. Importance of communications and commitment. Sharing of information. Use of workshops for facilitating teamwork.

Notwithstanding the above measures, workshops were regarded as being particularly effective when 'end-users' from client organisations are involved and where there is open and free flowing dialogue around risk management. Findings from literature have previously focused on project sponsors from client organisations as opposed to front of staff end-users in this regard (Chow *et al*., 2012). This represents a potentially important finding and departure from the literature. Furthermore performance related 'gain share/pain share' incentives are seen by participants as requiring robust and transparent key performance indicators. These should be easily and objectively measured against established agreed benchmarks to avoid disputes arising. An example might include financial incentives being based on savings achieved against target cost plans. Other forms of incentives could be effective through staff recognition schemes and as part of 'Investors in People' initiatives. One participant commented that "...we build recognition through our Investors in People goal and this empowers our project teams to understand the desired ways of working whilst embedding collaborative trust in others."

Although securing the commitment of senior management is regarded as a highly effective trust building mechanism from the interviews, the study found that this is predicated on college executives embracing partnering philosophies. Where such senior decision makers advocate lowest price tendering in the guise of obtaining best value for governance adherence, it can have a negative effect on trust and represents a major barrier for FE partnering strategies in such cases. The study found this to be an interesting new insight to existing thinking. Furthermore there were other trust

building mechanisms including social functions and facilitating networking events which are considered less effective at generating trust in partnering arrangements.

In light of these considerations, it can be suggested that organisations should focus more on strategic initiatives linked with the aforementioned top five influencing trust building mechanisms. These could include improvements to communication strategies as one example. Such mechanisms could become part of a 'partnering toolkit', geared to raising trust levels between project partners. Conversely the findings also suggest that there should be less emphasis on arranging social functions and events (of a non-workshop nature), preparing partnering charters and adopting restrictive recruitment policies around membership of professional bodies. Strategic partnering was felt to offer more beneficial outcomes and be more conducive to procuring successful collaborative outcomes than project-specific partnering. This was explained by the perceived willingness to invest more in resources and based on the expected longevity of future relationships and work streams in the former case.

The overarching consensus emanating from this study supports the notion that trust building mechanisms play an extremely important role in influencing the levels and quality of trust in partnering. However the level of influence is dependent on the suitability and adaptability of different project types to partnering. Complex projects of longer duration are found to give more scope and opportunities for trust development within project teams. Perhaps these findings present a further new insight into the nature of such projects, with those complex projects which place more demand on integration and communications between teams, creating more trust.

CONCLUSIONS

The study has acknowledged through the literature and research findings that there is an apparent lack of trust in partnering procurement strategies and responded to the lack of attention paid to the role and development of trust building mechanisms in the past. This certainly appears to be a major obstacle for realising the potential benefits of partnering strategies, here explored within the FE sector. In addressing this challenging dilemma the study has focused 'upstream' on those constructs, attributes and factors which could influence trust and offered a greater understanding of those trust building mechanisms that are potentially effective in 'turning the tide' and embedding more trust in partnering. Trust building mechanisms have been established by this study as having a very strong influence on raising trust levels on partnering projects in the FE sector. Examples of successful initiatives and measures previously adopted by participants have been identified for contemplation. These include strategies around incentive provisions, workshops, CPD, collaboration management systems, senior management commitment, open and joint evaluation policies and improved communications. Such measures or mechanisms are designed to increase the low levels of trust that exist on projects in pursuit of more successful project outcomes. They are, however, heavily reliant on establishing mutually aligned corporate objectives between partnering organisations. Furthermore they may provide the catalyst that 'keeps the partnering trust flag flying' in this regard, especially in the FE sector which has seen a reduction in this procurement approach for construction projects in recent years.

The study identifies barriers and obstacles to trust generation within partnering strategies. These mostly revolve around commercial issues and traditional attitudes of client senior managers still favouring lowest price tendering. Perhaps the biggest challenges remain around culture change within the UK construction industry and

seeking longer term collaborative relationships between partnering organisations. Finally action research is recommended to further explore some of the trust building mechanisms and initiatives that this study has identified when applied in practice. Such research could form part of case studies for future FE construction projects and assist in developing a framework or 'toolkit' for increasing trust in FE College partnering strategies.

REFERENCES

Amaratunga, D, Baldrey, D, Sarshar, M and Newton, R (2002) Quantitative and qualitative research in the built environment: Application of a mixed research approach. *Work Study*, **51**(1), 17-31.

Beach, R, Webster, M and Campbell, KM (2005) An evaluation of partnership development in the construction industry. *International Journal of Project Management*, **23**(8), 611-621.

Chan, A P C, Chan, D W M, Chiang, Y, Tang, B, Chan, E H W and Ho, K S K (2004) Exploring critical success factors for partnering in construction projects. *Journal of Construction Engineering and Management*, **130**(2), 188-89.

Cheung, S O, Wong, W K, Yiu, T W and Pang, H Y (2011) Developing a trust inventory for construction contracting. *International Journal of Project Management*, **29**(2), 184-196.

Chow, P T, Cheung, S O and Chan, K Y (2012) Trust-building in construction contracting: Mechanism and expectation. *International Journal of Project Management*, **30**(8), 927-937.

George, D and Mallery, P (2003) *SPSS for Windows Step by Step: A Simple Guide and Reference. 11.0 update 4th edition*. Boston: Allyn and Bacon.

Harris, F and Lyon, F (2013) Trans-disciplinary environmental research: Building trust across professional cultures. *Environmental Science and Policy*, **31**, 109-119.

Higgins, J (2003) *Introduction to Modern Nonparametric Statistics 1st Edition*. Cengauge. Duxbury Advanced Series.

Hoxley, M (2008) Questionnaire design and factor analysis. *In*: A Knight and L Ruddock (Eds.) *Advanced Research Methods in the Built Environment*. Chichester, West Sussex: Wiley-Blackwell, 123-126.

Huang, Y and Wilkinson, I F (2013) The dynamics and evolution of trust in business relationships. *Industrial Marketing Management*, **42**(3), 455-465.

Huemer, L (2004) Activating trust: the redefinition of roles and relationships in an international construction project. *International Marketing Review*, **21**(2), 187-201.

Kalla, S (2009) *Statistical Treatment of Data*. Available from https://explorable.com/statistical-treatment-of-data [Accessed 7th September 2015].

Pinto, J K, Slevin, D P and English, B (2009) Trust in projects: an empirical assessment of owner/contractor relationships. *International Journal of Project Management*, **27**(6), 638-648.

RICS (2003) *Proceedings of the RICS Foundation Construction and Building Research Conference (COBRA 2003), University of Wolverhampton. 1st -2nd September 2003*. RICS.

Ross, A (2011) Supply chain management in an uncertain economic climate: A UK perspective. *Construction Innovation*, **11**(1), 5-13.

Silva, S C, Bradley, F and Sousa, C M P (2012) Empirical test of the trust performance link in an international alliances context. *International Business Review*, **21**(2), 293-306.

Thorgren, S, Wincent, J and Eriksson, J (2011) Too small or too large to trust your partners in multi-partner alliances? The role of effort in initiating generalized exchanges. *Scandinavian Journal of Management*, **27**(1), 99-112.

Tyler, T R and Blader, S L (2003) The group engagement model: Procedural justice, social identity and cooperative behaviour. *Personality and Social Psychology Review*, 7(4), 349-361.

Wong, W K, Cheung, S O, Yiu, T W and Pang, H Y (2008) A framework for trust in construction contracting. *International Journal of Project Management*, **26**(8), 821-829.

THE DIMENSIONALITY OF PUBLIC TRUST IN PUBLIC PRIVATE PARTNERSHIP PROJECTS

Diane Christina[1], Martin Loosemore and Sydney Newton

UNSW Built Environment, Red Centre Building, Kensington Campus, Sydney NSW 2052, Australia

Public Private Partnerships (PPPs) are becoming increasingly popular around the world. However, concerns around the politicisation, transparency and failure of numerous PPP have fuelled community mistrust in official government messages about the economic, social and environmental risks and opportunities of these projects. While community trust in government initiatives has been explored by social psychologists in numerous controversial policy areas such as nuclear power and genetic engineering, PPP projects have been ignored in these analyses. Similarly, while the subject of risk in PPPs has been explored extensively in construction management research from an 'insider's' perspective, the challenge of managing 'outside' community concerns about these projects, has been largely neglected. To address these gaps in knowledge, a new conceptual framework is presented which is based on an integration of Poortinga and Pidgeon's (2003) Dimensionality of Trust theory, Kasperson *et al.*'s (2003) theory of risk perception and Rowe and Frewer's (2005) typology of public engagement. Using these new theoretical lenses, a number of important propositions are derived to guide future empirical work in this area.

Keywords: community, consultation, engagement, perceptions, public private partnerships, risk, trust.

INTRODUCTION

While there is a whole spectrum of public private partnership (PPP) models, PPPs generally involve a private sector consortium forming a special purpose vehicle (SPV) to finance, design, construct and operate public infrastructure against pre-defined service standards (Grimsey and Lewis 2000, Eadie *et al.* 2013). The PPP debate is a highly politicised and contested arena. While many governments, researchers and commentators advocate the benefits of PPPs, there are an equal number of critics which question the validity, bias and reasoning underlying these claims. For example, the Australia Productivity Commission (2014) cite many benefits of PPPs such as better value for money, lower life cycle costs, more innovation, integrated procurement and services, better risk management and better public services. However, it also cites a whole range of challenges including: Governance (lack of transparency in project selection; politicisation of decision-making around projects; poor or unclear business case for projects etc.); Procurement (poor project planning and feasibility; rushed projects; contractual complexity; high bid/transaction costs; lack of competition etc.); Risk management (poor risk assessment; inappropriate risk allocation - culture of risk transfer; optimism bias around issues such as patronage; public risk perceptions/mistrust in government around political motives, privatisation

[1] diane.chandra@unsw.edu.au

Christina, D, Loosemore, M and Newton, S (2016) The Dimensionality of Public Trust in Public Private Partnership Projects. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 903-910.

of public assets, poor business cases and low value for money etc.); Skills (low public sector skills in areas like negotiation and bid assessment around value for money; poor communication between public and private sectors; SPV management) and Data (lack of research, empirical data and analytics around value for money and costs and benefits of projects and about successes and failures).

Many of these challenges have already been extensively investigated in the PPP literature (Bing *et al.* 2005, Akintoye *et al.* 2003, Akintoye and Beck 2009, Cheung *et al.* 2014, Nguyen *et al.* 2014). However, the issue of community trust in PPPs has not yet been investigated and nor has a theoretical foundation been established to do so. The While there has been a large amount of excellent research looking at the risks of PPP's, it has primarily been from the 'internal' perspective of the project participants and community perspectives have been largely missing (Siemiatycki and Farooqi 2012, Ng and Loosemore 2006). This 'internal' focus is also reflected in the considerable work on trust in construction which has largely focussed on trust between internal team members rather than between the community and the project representatives (Badenfelt 2007, Brewer and Strahorn 2012, Ceric, 2014, 2016). Furthermore, although the issue of community trust in the construction industry are beginning to be explored in the construction management field (Teo and Loosemore 2010, Close and Loosemore 2014), PPP projects have never been a specific focus of research in this area. This is despite trust being implied as critical to the concept of PPPs by the term 'partnership' being central to its title.

It is within this context that the aim of this paper is to explore the issue of public trust in PPP projects by merging theories of trust, risk perception and community engagement to create a theoretical foundation on which to base future empirical research in this area. Three propositions are developed and presented to provide the foundation for future emperical work which will help advance PPP policy and practice by enabling policy makers to better build community trust in PPP projects. This is important for a number of reasons. First, the Productivity Commission (2014) cites community concerns about numerous PPP projects which have become highly politicised and gone ahead without a clear business case, thereby exacerbating levels of community mistrust in this procurement approach. Second, the conceptual framework developed addresses three significant gaps in knowledge: the lack of externally orientated PPP risk research; the lack of PPP focus in community-based research; and the lack of community focus in construction trust research. Third, not only are PPPs becoming more popular around the world as a relational procurement approach, but PPP projects present special challenges in terms of community trust. PPP's are typically large complex and controversial projects which have significant environmental and social impacts on the communities in which they are built. As Loosemore and Close (2014) show, communities are seen as a risk rather than an asset by most construction project managers and as Sharp (2004: 8) noted, while PPP projects might offer creative solutions to public infrastructure needs "Any PPP lives or dies on its reputation with these people".

THEORISING COMMUNITY TRUST IN PPP PROJECTS

A 'community' refers to a social unit that shares common values and interests and which normally lives in close proximity (Parsons, 2008). From the perspective of a construction project, 'community' refers to the people who perceive their interests to be affected by that project (Loosemore and Close). Atkinson and Cope's (1997) analysis of community participation and activism in urban regeneration projects

showed that communities cannot be treated as a single homogeneous, easily identifiable group and Teo and Loosemore (2011) showed that in reality, communities affected by construction projects are far more dynamic and complex than first thought.

Theoretically, trust is a social and psychological construct which is used to define the nature and quality of relationships between actors in a social system. Trust is not just an interpersonal phenomenon but is also of relevance to relationships within and between social groups such as communities and organisations (Hardin 2002). Rousseau *et al.* (1998) conceptualize trust across a number of disciplines defining it as a reflection of the degree to which one party is willing to accept vulnerability in a social relationship based on beliefs about the honesty, fairness and altruism of another party. Trust is the act of believing that the trustee can be relied upon to do what is expected and to not intentionally harm the trustor. Mollering (2005) argues that the act of trusting another person is one of the methods by which people resolve dependencies where there are significant power differentials to be navigated. This relationship between trust, uncertainty, complexity and power is particularly relevant in the context of PPP projects because of the high levels of uncertainty and complexity which characterise them and the power differentials which can exist between communities, governments and SPVs.

Job's (2005) notes that research into community trust in government is increasingly popular due to the increasing publication of scandals which suggest abuses of power and control, poor governance and a lack of ethics and honesty. She also shows that that community trust in government can either be theorised as rational (based on data and evidence and calculate) or relational (based on faith) and that both are at work in shaping the community's trust in government. Drawing on this extensive literature around community trust in government, Poortinga and Pidgeon (2003) provide empirical evidence to show that community trust can be synthesised into two main dimensions: a *general trust* dimension which is concerned with issues such as competence, fairness and openness; and a *scepticism* dimension that is concerned with the process by which risk policies and regulations are brought about and enacted and with the enactor's credibility and reliability. Based on these two new dimensions of trust, Poortinga and Pidgeon (2003) produced a typology which identified four main types of trust ranging from outright distrust - to rejection based on cynicism - to critical trust based on a healthy level of scepticism (the most healthy form of trust according to Poortinga and Pidgeon) - to uncritical emotional acceptance. Drawing on their dimensionality of trust model and extending it to PPPs it is possible to develop a proposition (conceptualised in Figure 1) that different members of the community might have different types of trust in government.

> *Proposition 1: Different groups in the community have different types of trust in government about PPP projects.*

The (P1) branch in Figure 1 uses Poortinga and Pidgeon's (2003) theory to hypothesise that people from the community affected by a PPP project can be categorised into four groups depending on the type of trust they have in a government communications about a PPP project (critical, acceptance, distrust and rejection). As shown in Figure 1, this categorisation is based on how community members differ in their attitudes towards government communications about PPPs across seven categories as detailed in Table 1.

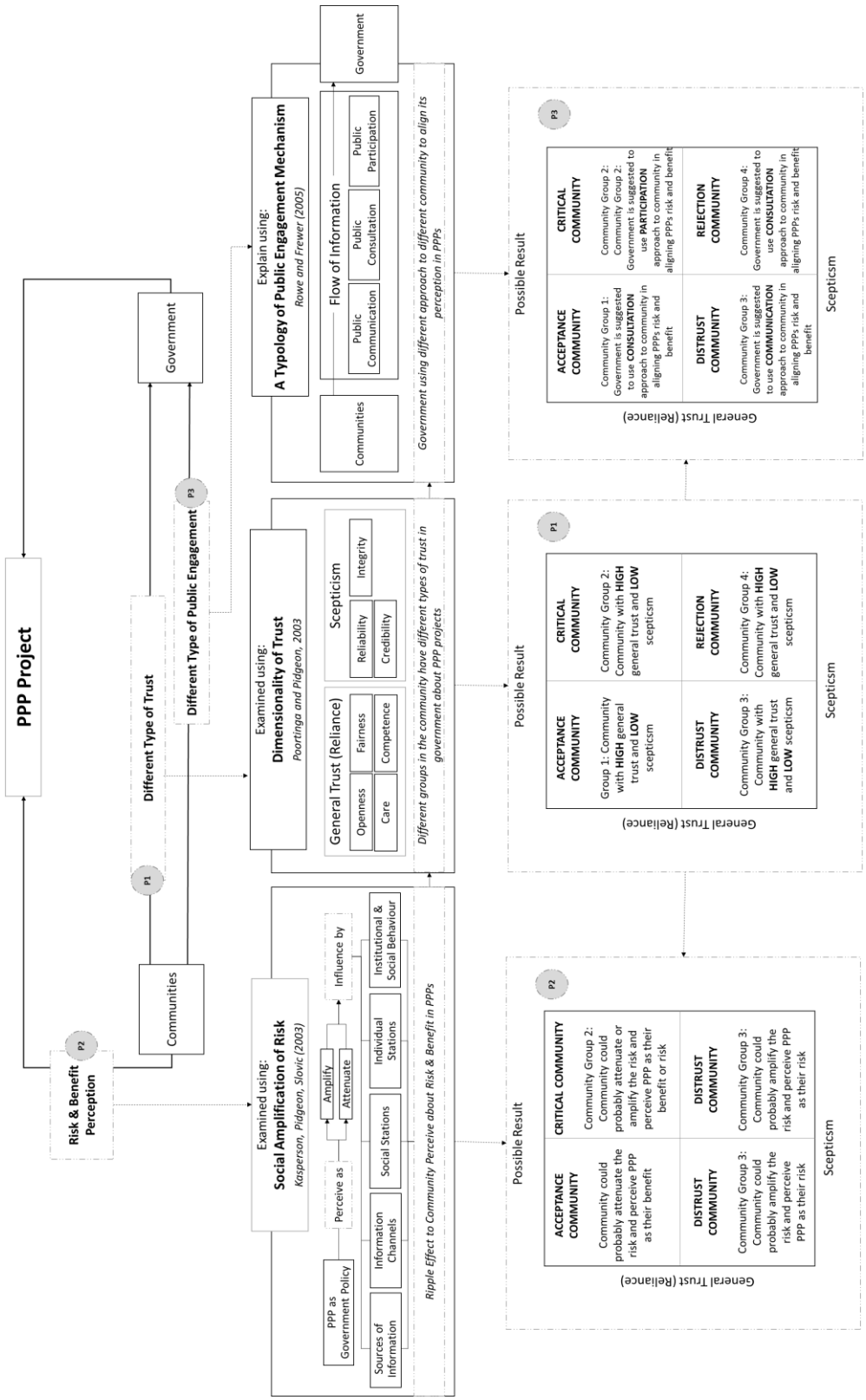


Figure 2 Conceptual model

While valuable in identifying different types of trust associated with different stakeholder groups in the community, Poortinga and Pidgeon's (2003) model does not explain how each type of trust group in the community would perceive the risk and opportunity of a potential PPP project.

This omission is conceptualised in Figure 1, by the (P2) branch which integrates Kasperson *et al.*'s (2003) theory of risk model with Poortinga and Pidgeon's typologies of trust model, representing an important extension of our understanding of community trust in PPPs by linking, for the first time, different types and dimensionalities of trust with different social amplification of risk factors.

Kasperson *et al.*'s (2003) work is particularly valuable in that it explains the factors that might determine the social amplification and attenuation of risk for different community groups identified through Portinger and Pidgeon's model.

Table 1 Dimensionalities of trust variables

Category	Description
1 Openness	Does the government provide all relevant information about a PPP project?
2 Reliability	Does the government change policies around PPP projects without explanation?
3 Integrity	Is the government PPP policy influenced by the private sector?
4 Credibility	Does the government distort facts about PPP projects?
5 Fairness	Are decisions about PPP projects fair?
6 Care	Is the government acting in the public's interests?
	Does the government listen to community concerns?
	Does the government care about what the community thinks?
7 Competence	Is the government doing a good job?
	Does government have the competence to represent community interests?
	Does the government have skilled people to deliver the project effectively?

The value of this model is that it explains how technical assessments of risk by experts can differ significantly from community perceptions of risk due to psychological, social, institutional and cultural processes which can act to attenuate or amplify community responses to a risk or risk event such as a PPP project. The social amplification - attenuation process acts as a corrective mechanism by which communities bring technical assessments of risk by experts into line with their own psychological, social, institutional and cultural perception of the risk posed. According to Kasperson *et al.* (2003) amplification/attenuation occurs at two stages: in the transfer of information about the risk and in the response mechanisms of society. Risk information is acquired in a number of ways from different sources of information and through different information channels through personal experience, direct communication or indirect communication through professional brokers and social networks. Risk signals are processed by both individual and social amplification stations. Individual stations include decoding processes, heuristics and attention filters which social stations include technical experts, government agencies, opinion leaders, media and formal and informal networks. The risk perceptions which result from these processes then spawn different behavioural responses (such as protest, political and social action, attitude changes) which in-turn results in secondary impacts (such as litigation, financial loss, loss of confidence etc.) which cause further changes to community risk perceptions and so on.

By integrating Kasperson *et al.*'s (2003) ideas into Poortinga and Pidgeon's model it is possible to develop a second proposition that:

> *Proposition 2: Different types of community trust in government are associated with different perceptions of risk in PPP projects*

While valuable as a new framework to explain how different community groups might perceive PPP projects based on a typology of trust and risk amplification framework, the limitation of Figure 1 with just the (P1) and (P2) branches is that it does not link different community groups and their unique perceptions of risk with different community engagement strategies. This is important for policy-makers to understand the types of community engagement strategies which are most effective in building 'critical community trust" in their communications about PPPs. To this end, Rowe and Frewer's (2005) typology of public engagement mechanisms is particularly useful. Rowe and Frewer (2005) constructed their model based on a secondary analysis of the extensive literature in the community engagement field and out of frustration with the imprecise key terms in the public participation domain, which they argue has hindered good research. Public engagement is enacted through a wide variety of mechanisms and Row and Frewer (2005) the literature into three main domains which they label: public communication; public consultation; and public participation. In the resultant typology, each of these broad approaches to community engagement comprise different mechanisms differentiated by the nature and low of information between sponsors and participants. In the public communication group there are four sub categories of mechanisms (information broadcast, public hearings, drop in centres and hotlines). In the public consultation group there are six sub categories (opinion poll, consultation documents, electronic consultation, focus groups, study circles and citizen panels). Finally, in the public participation group there are four sub categories (action planning workshop, task force, deliberative planning polls and town meetings).

When Rowe and Frewer's (2005) typology of public engagement mechanisms is used to extend Figure 1, the resultant conceptual model is extended into the (P3) branch which shows that different groups in the community which might have different types of trust in government communications about PPPs and different perceptions of risk associated with these project are likely to be associated with different government approaches to community engagement. Given that critical trust is the ideal type of trust in Poortinga and Pidgeon's (2003), this provides the conceptual basis to explore a third important proposition that:

> *Proposition 3: The development of critical trust in PPP projects requires a particular community engagement strategy*

The next phase of this research is to use the theoretical model and propositions derived and proposed in this paper as a foundation for single case study-based empirical research using the individual community member as the unit of analysis. This approach will be adopted for a range of reasons. First single cased studies allow an intensity of focus which are not afforded by multiple case study research, allowing complex social phenomenon such as community trust to be deeply investigated in a specific context and natural setting (Flyvbjerg 2006). Flyvbjerg (2006) acknowledges that case study research has often been criticized on the grounds that its findings are not generalizable, but he also argues that universal truths are problematic in the study of human affairs and that context-dependent knowledge and explorative insights gained through case study research is arguably more valuable than the explorative search for predictive theories and cause and effect relationships. As Berg (2001) asserts, while the advantage of large samples is breadth, the advantage of a small number of case studies is depth and validity which can be achieved by immersion in the research setting which case studies facilitate. The case will be a controversial PPP project which bring community trust to the surface and enable it to be investigated

rigorously using a mixture of methods including surveys, interviews, observations, and documentary inspection which is normal in case study research. This empirical outcomes of this research will be reported in future papers.

CONCLUSION

The aim of this theoretical paper was to explore the issue of public trust in PPP projects by merging theories of trust, risk perception and community engagement to create a theoretical foundation on which to base future empirical research in this area. The overall objective was to advance theoretical understanding of PPP projects from a community perspective by producing a new conceptual model of factors that shape community trust in PPP projects which will contribute to the advancement of PPP policy and practice by enabling policy makers to better build community trust in PPP projects. By integrating Poortinga and Pidgeon's (2003) theories of community trust in government with Kasperson *et al.*'s (2003) theories of social amplification of risk and Rowe and Frewer (2005) theories on typology of public engagement mechanisms a new conceptual framework and series of proposition has been presented to explore the important but as yet unexplored issue of community trust in PPP projects. The value of this model is in the integration of previously disconnected theories from the fields of risk communication, risk perceptions and community engagement, to better understand the process by which trust is formed in communities about PPP projects. This represents an important new dimension and re-orientation of PPP research which has hithertoo largely focussed on the management of internal risks between SPV members. While this previous work has been important in ensuring that PPP projects operate effectively, a better understanding of how PPPs are perceived by communities is important in ensuring that such projects are granted a social licence to operate by the communities in which they are built. As the discussion above demonstartes, too often PPPs have been imposed on communities without the resolution of widespread and legitimate concerns. These ongoing and unresolved controversies reflect a significant gap in perceptions about the risks and opportunities associated with PPP projects between communities and those who propose them, which lies at the heart of increasing community scepticism about government communications around PPP projects.

REFERENCES

Akintoye, A. Beck, M. and Hardcastle, C. (2003) *Public-Private Partnerships: Managing Risks and Opportunities*. Oxford: Blackwell.

Akintoye, A. and Beck, M. (2009) *Policy, Finance and Management for Public-Private Partnership*. Oxford: Blackwell.

Atkinson R and Cope, S (1997) Community participation in urban regeneration in Britain. *In*: P Hoggett (Ed.) *Contested Communities*, Bristol: Policy Press, 201-221

Badenfelt, U (2007) Trust and control in the early phases of target cost contracts. *In*: D Boyd (Ed.) *Proceedings 23rd Annual ARCOM Conference, 3-5 September 2007, Belfast, UK*. Association of Researchers in Construction Management, Vol. 1, 23-32.

Brewer, G and Strahorn, S (2012) Trust and the Project Management Body of Knowledge. Engineering. *Construction and Architectural Management*, **19**(3), 286-305.

Ceric, A (2014b) Communication risk and trust in construction projects: A framework for interdisciplinary research. *In*: A Raiden and E Aboagye-Nimo (Eds.) Proceedings 30th Annual ARCOM Conference, 1-3 September 2014, Portsmouth, UK, Association of Researchers in Construction Management, 835–44.

Ceric (2016) *Trust in Construction Projects*, London: Routledge.

Cheung, E, Loosemore, M and Chandra, D C (2014) Assessing risk dynamics in Public Private Partnership projects, *In*: A Raiden and E Aboagye-Nimo (Eds) *Procs of 30th Annual ARCOM Conference, 1-3 Sept, 2014, Portsmouth, UK*. Association of Researchers in Construction Management, 1381-1389

Close, R and Loosemore M (2013) Community consultation during construction: attitudes, experiences and skills. *In*: S D Smith, and D D Ahiaga-Dagbui (Eds.) *Procs 29th Annual ARCOM Conference, 2-4 September 2013, Reading, UK*, Association of Researchers in Construction Management, 849-858.

Eadie, R, Millar, P and Grant, R (2013) PFI/PPP Private sector perspectives on UK transport and healthcare. *Built Environment and Project Asset Management*, **3**(1), 89-104.

Flyvbjerg, B (2006) Five misunderstandings about case study research. *Qualitative Inquiry*, **12**(1), 219-245.

Grimsey, D and Lewis, M K (2000) Evaluating the risks of public private partnerships for infrastructure projects. *International Journal of Project Management*, **20**(2), 107-118

Kasperson, R, Renn O, Slovic, P, Brown, H, Emel, J, Goble, R, and Ratick, S (1988) The social amplification of risk: A conceptual framework. *Risk analysis*, **8**(1), 177-187.

NG, A and Loosemore, M (2007) Risk allocation in the private provision of public infrastructure. *International Journal of Project Management*, **25**(1), 66-76.

Nguyen N M, Lewis, J, Beer, M and Boussabaine, A (2014) A pilot study investigating the assessment and allocation of risk in public private partnership transportation projects in Vietnam. *In*: A Raiden and E Aboagye-Nimo (Eds.) *Procs of 30th Annual ARCOM Conference, 1-3 Sept, 2014, Portsmouth, UK*, Association of Researchers in Construction Management, 1421-1430

NG, A and Loosemore, M (2007) Risk allocation in the private provision of public infrastructure. *International Journal of Project Management*, **25**(1), 66-76.

Parsons R, (2008) *Constructions of 'Community Engagement' In The Australian Minerals Industry*. School of Business University of Queensland, Doctoral Thesis.

Productivity Commissions (2014) *Productivity Commission Inquiry Report*. Australian Government Productivity Commissions, Australian Government Canberra, Australia

Poortinga, W and Pidgeon, N F (2003) Exploring the dimensionality of trust in risk regulation. *Risk Analysis*, **23**(5), 961-972

Rowe G and Frewer L J (2005) A typology of public engagement mechanisms. *Science, Technology and Human Values*, **30**(2), 251-290

Rousseau D M, Sitkin, S B, Burt R S and Camerer, C (1998) Not so different after all: a cross discipline view of trust. *Academy of Management Review*, **23**(3), 393-404

Sharpe, W (2004) Talking points: Managing stakeholder relations in PPP projects. *Public Infrastructure Bulletin*, March, 8-15.

Siemiatycki, M and Farooqi, N (2012) Value for money and risk in public-private partnerships: Evaluating the evidence. *Journal of the American Planning Association*, **78**(3), 286-289

Teo, M and Loosemore, M (2011) Community-based protest against construction projects: A case study of movement continuity. *Construction Management and Economics*, **29** (2), 131-144.

PROJECT MANAGEMENT PRACTICE WITHIN THE LEBANESE REAL ESTATE INDUSTRY

Maya Feghali[1] and Ani Raiden

Nottingham Business School, Nottingham Trent University, Burton Street, Nottingham, NG1 4BU, UK

Many investors have recently discovered the emerging Lebanese real estate market as an opportunity for a very lucrative business. However, historically the Lebanese market has been characterised by precariousness due to political instability, environmental risks, funding difficulties, demographics and cultural issues. We investigate project management practices within the Lebanese real estate sector through an inductive study. A multidimensional stakeholder approach is employed. The findings from seven data rich, semi-structured interviews with different stakeholders highlight project financing, time management and human resources management central to successful project management practice in Lebanon. While the respondents make frequent references to the unique context in Lebanon our analysis reveals more similarities than differences with the universalist best practice literature on project management. We evaluate the relevance of contextual and best practice approaches to project management and consider some of the reasons why the respondents at strategic level tend to take a more contextual approach where the views at meso and micro levels are more mixed. Later stages of this study will utilise the research findings in the development of a success measurement framework that accounts for diverse success criteria in the Lebanese market through a larger scale mixed-method programme of research.

Keywords: project management practice, Lebanon, project finance, time management, human resource management.

INTRODUCTION

This study investigates project management practices within the Lebanese real estate sector employing a multidimensional stakeholder approach. The research question is: What are the central elements of project management practice within Lebanese real estate projects?

The research context: Real estate in Lebanon

The real estate sector in Lebanon is the research context in this study. This is of interest to us because many investors have discovered the emerging Lebanese real estate market and an opportunity for a very lucrative business. The overall industry, ranging from construction and property development to facility management, has benefited from these investments. Bold marketing strategies, including large advertising campaigns using big billboards, television shows and radio; important launching events; and finally a recent "Facebook war" showcase the interests of multiple stakeholders in the market. Project management training and certification is also an increasingly attractive prospect which professionals in this space are using to

[1] ani.raiden@ntu.ac.uk

Feghali, M and Raiden, A (2016) Project Management Practice within the Lebanese Real Estate Industry. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 911-920.

enhance their career development (see for example Amideast, 2016). Thus it is timely to begin the first study of project management practice in Lebanese real estate sector.

PROJECT MANAGEMENT PRACTICE

Project management practice refers to the combination of (i) use of tools and techniques in managing projects (after Bresner and Hobbs, 2008), and (ii) the experiences of those involved with projects, be that managing projects (after White and Fortune, 2002), investing in projects or working on projects. Project management practice is now commonplace across most if not quite all sectors including construction and real estate, hence the birth of generic manuals and toolsets such as the PMBOK (Project Management Institute, 2013). Research on 'best practice' is also extensive (see for example International Journal of Construction Project Management and/ or Construction Management and Economics). The best practice literature seeks to specify a given tool and/ or process that will achieve the optimum outcome be that in planning, procurement or performance management (or any other aspect of project management). The advocated benefits of using best practice include for example the assurance that the organisation is using what is considered to be best-practice; demand from external customers that a recognised methodology is used; assistance with external recruitment; and the availability of suppliers of the methodology for training and support, according to Mchugh and Hogan (2011). Possible downsides include ill-fit within a given context.

Here arises the core argument for the contextual approach (Besner and Hobbs, 2013; Gorog, 2012) which recognises that each organisation is unique and all projects are different to an extent and thus there is a need for determining what is appropriate for any given project. Some (e.g. Kerzner, 2014) straddle the ground in between best practice and the contextual approach arguing that each organisation can develop its own best practice, although to us this aligns more closely with the contextual approach. Regardless of the stand one takes, generally project management has been hailed as "the tool" which will help achieve successful business outcomes. With regards to real estate in Lebanon, project management is seen as the tool which will help capitalise on the current interest and secure successful real estate project outcomes for all stakeholders.

RESEARCH METHOD

Our research seeks to elicit the study participants' perceptions of project management practice in Lebanon, thus an interpretivist paradigm is well suited to such subjective assessment and research (Bryman and Bell, 2015: 28). Rich, qualitative data were gathered through informal interviews. An innovative interview technique was employed to encourage considered responses from the participants. First, the participants were asked to describe the Lebanese context, the risks involved and give an account for their personal experiences in the real estate sector. Magazine articles were then used to develop the discussion and open up critical dialogue. Contradictory statements in the articles were highlighted in order to gasp the participants' views regarding the real estate sector. The articles used included:

- *Empty Towers - Just Because You Build It Does Not Mean Buyers Will Come* (Nash, 2014) from the business and finance section of Executive magazine;
- *The Slump Begins To Hurt: Developers Are Cutting Prices And Looking Abroad To Up Their Cash Flow* (Nash, 2014) also from the Executive magazine;

- *2014 Has Been A Hard Year For Developers* (Yerevanian, 2014) Sayfco Holding Publication;
- *A Phoenix From The Ashes* (2015) The Telegraph, Beirut portrayed for property experts and global investors; and
- *A Rising Star On The World Stage* (White, 2015) The Telegraph, Beirut portrayed for real estate investors.

The interviews then developed open discussion about the respondents' views on project management practice in Lebanon. All interviews were conducted in English, audio-recorded and then transcribed verbatim (with the exception of interview five who did not want to be recorded and so extensive notes were taken). The researcher's notes together with the interview transcript data were converted into matrix of categories. Patterns were studied in the form of themes, categories and concepts. Thematic analysis was then used for the identification of common themes.

Multidimensional stakeholder approach

A multidimensional stakeholder approach was adopted due to the importance of different project stakeholders' satisfaction on project outcomes. Based on purposive sampling, seven key stakeholders within the Lebanese real estate sector were interviewed. They included engineers, architects, project managers, general managers and investors. The study participants were carefully chosen from different organizations and in different positions in order to ensure coverage and sufficient variance of perspectives. At the same time, purposive sampling enabled the researcher to meet the goals defined for research in conjunction with controlling the level of variations among the interviewees (Bazeley, 2013). Stakeholders' views can be divided between the macro, meso and micro levels, as shown in Table 2:

Table 2: Interview participants

	Interviewee No
Macro level/ Strategy level	2, 3, 5
Meso/ Input to both Strategy and Projects	6, 7
Micro level/ Project level	1, 4

The interviewees' background and/ or gender and age group added interest to the results. For instance, interview one was with a female architect/ project manager (42 years old); interview two was with a male financial analyst/ investor (33 years old) and interview three was with a male engineer/ general manager (67 years old).

After the seventh interview, data saturation was attained and since no further new information was disclosed data collection was terminated (after Strauss and Corbin, 1998).

RESEARCH FINDINGS

Three key themes emerged during our analysis of the data: project finance, time management and human resource management.

Project finance

Partly because of the interview technique employed, partly because of the interviewees' responses, the context arose to the fore during the analysis of the interview data. Many reflected on the historic developments that have led to the

situation today and how they have shaped the Lebanese real estate sector. We summarise the key points that emerged from their reflections below:

> After 20 years of a damaging civil war, the beginning of the 1990's positioned Lebanon on a path of reconstruction, economic revitalization and recovery. The state of the economy was immediately and very positively affected by the reconstruction. GDP growth rates were high and the currency stabilised. The former Prime Minister Rafic Hariri attracted huge capital investment into the construction sector mainly from Lebanese expatriates and Arab Gulf investors. However, the new economic energy was faced with many political crises over the years. For example, Prime Minister Rafic Hariri's assassination in 2005 had an adverse effect on the economy and the July 2006 war on Lebanon inflicted approximately $3.5 billion in direct damages alone, leaving the GDP with a 6.4% decrease in the following year.

Recently, an IMF report credited Lebanon's escape from the global crisis to conservative funding and asset structures based on prudent banking regulation and supervision (International Monetary Fund, 2010). Despite profitability, well-capitalization, high liquidity and high interest rates, growth opportunities and real estate investment from outside of Lebanon are more interesting (Byblos Bank, 2015). According to the interview with the financial consultant (I2), if it was not for the facilities offered by the Central Bank of Lebanon through the different loan packages available and the low interest rates, the state of the Lebanese economy and specially the property sector would be alarming. I2 claimed that the incentives offered by the Central bank of Lebanon are the only force keeping the market floating. I7 also mentioned:

> ... the Lebanese people that live outside Lebanon (the expatriates) who trust the Lebanese banking sector ... keep their money in Lebanon due to low tax on the revenues and good profits ... this money is usually going to the real estate sector. (I7)

Most of these real estate and development companies were established by private investors. Highest boom today is in the mid to lower end of the market. In the interview with I5, the research participant discussed how he is turning towards the construction of affordable apartments in search of profit. He had bought a land in Baabda region of around 10,000 sq.m to develop his next project and claims that:

> ...I will start my next project this year... my business is doing fine... because I saw a slowdown early on and focused on building smaller, more affordable housing units. (I5)

Most study participants agreed that the Lebanese economy and real estate sector is much more stable than it looks from the outside. I4 mentioned the large influx of money from Lebanese expatriates who always look for opportunities to invest in their home country:

> ... the real estate business in Lebanon is mainly based on the people living outside Lebanon. (I4)

I2 was confident that the real estate sector is not heading towards the crisis cliff:

> ... the demand in Lebanon is very organic and natural. You do not have speculations like the rest of the world. The people who are buying properties ... need it. (I2)

I2 further elaborated on the above and linked the discussion with the Lebanese culture and a sense of belonging:

> Lebanon is a small country and has exposure to lots of Lebanese expatriates. The culture in Lebanon forces the expats to come back to their home country and own a house or ideally a piece of land where they grow up because they feel a sense of belonging. They are willing to take the risks involved because we have some sort of attachment to the country. You cannot take a calculated risk in Lebanon. The security

> question is always beyond Lebanon, it's a regional issue because Lebanon is a small country. Every project in Lebanon is successful, because it is coming from Lebanese local attachment, and they are willing to take the risks and wait. (I2)

The research interviews located success on two dimensions - macro and micro - depending on the stakeholders' involvement with the project. For example, the general manager (I3) linked success to the investor capabilities and expectations and stressed on the need of adequate feasibility and market studies to account for the target buyers and their expectations He also assessed success in regards to the owner's benefits.

It is important for the real estate company to sustain the pillars of its reputation by reflecting a good impression to its clients and delivering value to its customers (Al-Tmeemy *et al*., 2011). In fact, the loss of reputation reflects the customer's attitude towards a company rather than towards an individual project (Harrington, 1999).

> ... as an investor or a buyer, if I am expecting an office or an apartment to be ready in one year and it is not ready in that time, then I will never invest again with the same company. (I7)

Further to Ren *et al*., (2013) work and based on the interview findings, the most commonly identified reasons for project success/ failure on the project level beyond the context are: time management and human resource management. These are discussed next.

Time management

The majority of the research participants talked about time being of essence to project management practice in Lebanon. Time was considered in very practical terms, for example in relation to project delivery schedules, but also in terms of timing of global crises (such as the war in Syria) and their impact on the Lebanese real estate sector. A frequency analysis of the interview transcripts in NVivo confirmed that time was one of the most frequent words used in discussions of successful project management practice. Finishing the project within the agreed time frame is a big determinant of a successful project for the different stakeholders in Lebanon.

> ... any delay in the project hand-over and delivery to the customer will harm your reputation and thus affect the success of your project... (I5)

Also, Lee *et al*., (2005) had previously revealed the importance of pre-project planning on the project performance. The importance of the adequate preparation before the launch of the project was underlined during the pilot interview (I1):

> ... I would like to emphasise that the initial clear planning had a big impact on the success because it was realistic and took into consideration the potential problems that we could later encounter in the project. (I1)

I1 linked project financing issues with the negative impact on the delivery time:

> ...there is political and economic struggle nowadays, so projects are taking more time to deliver them. This is due to the fact that there is less cash and investment and less buyers. Also, the condition in the region (war in Syria) is a factor that is affecting... (I1)

I7 further discussed the risks involved with the Lebanese context and mentioned the main attractive factors (weather) that are keeping this sector in a healthy shape:

> Now when it comes to risks, Lebanon is a very high risk country. Theoretically, when you have a high risk country, the situation is not stable enough to have a good construction activity. Even if you have well-known risks related to the Lebanese context, there are many attraction factors like the weather... compared to most of the

> Middle Eastern countries... It's considered as a summer escape for people of the Gulf area. That is why there is a big investment done by these people in the real estate sector... Even though negative external factors exist like the Syrian crisis and the political situation in Lebanon, there is a minimum level of stability that is keeping this domain, more or less, in a good shape. (I7)

Human Resources Management

This factor was frequently repeated by the study participants mostly because they linked it to other factors such as change management, risk management, decision making, leadership, motivation, communication, coordination, executive support and the use of appropriate frames for the monitoring and follow-up processes. Moreover, number of previous researchers had stressed on these human resources factors to achieve success. Nicolini (2002) introduced the concept of "project chemistry" to account for the value of interpersonal relations, project teams and collaboration in construction management, that contribute to project success or failure especially in construction.

Project managers and Project Chemistry emerged as central to human resource management:

> You have a lot of influence on the people working with you regarding motivation (I7).

> The different human resources in project management are a big part of success because usually the management is monitored by the human resources. The project management studies done by the project manager should start with the recruitment process and how to choose the right people... teamwork and working within a team can lead to a successful project because whenever there is an objective shared by the team for success, this can lead the whole project to success (I4).

According to Tennant *et al*., (2011), it will take more than a few well-meaning comments and good practices to build "true" team working in the construction industry.

> ...you need a project manager with an engineering technical background to know how to deal with problems... you also need a charismatic project manager. (I1)

Moreover, Kloppenborg and Opfer, (2002) had acknowledged, in their review of 3500 articles, journals and papers on project management, the "evolution of the project managers role" to reveal their ability as leaders and not just managers as a key trend. Leadership is different from management, requires different knowledge, different expertise, and accomplishes a different purpose: "management deals with the present; leadership deals with the future. Management deals with resources; leadership deals with people and personalities. Management deals with facts; leadership deals with ideas" (Van Ingen, 2007).

> ... a leader that motivates the people to work overtime because definitely when you encounter problems, you need to work overtime to be able to deliver on-time. But over-time means paying extra money, but the project manager he had a way to make people work without feeling that they were used and not paid, he made them feel that this project is special due to its uniqueness in Lebanon so they worked overtime and they were happy because they felt they were achieving something that was never achieved before. He knew how to motivate them intrinsically.... if you are not happy with the people around you that can de-motivate you. (I1)

Innovative practices require the adoption of non-confrontational attitudes, a collaborative spirit, and trust that, in turn, highlight the importance of social, human and cultural factors in the management of the construction organisations as well as projects (Akintoye *et al*., 2000).

> 90% of the project manager time is communication and coordination with all the stakeholders, human resources, investors... good communication and cooperation strategy are decisive factors in a successful project management application. (I6).

With regards to project control and decision-making project managers were also centrally located in ensuring success:

> Sometimes when you look at risks, the decision needed could be a sharp decision and have a high impact on the project (I7).

> ...bad decision making from the project manager can negatively affect this (project management) process (I1).

It is worth noting that I5 stressed on the importance of having project control procedures. Project control is a complex and iterative process that is usually achieved in three phases: setting performance standards, comparing actual performance with these standards, and then taking necessary corrective actions and remedy measures.

> ... we have policies and procedures and working structure put in place for that. Sometimes they don't use it well or because they don't feel like wasting their time reading and filling up forms, so we have ... an inspector to go and make sure through the stages of the project, if the organisation policies and procedures are being applied and they raise their reports when they go on inspection visits. We then have to follow-up on these findings from the reports, to do some corrective actions ... (I6)

Moreover, this issue was given importance when the frames used by the different interviewees in their operations in order to check project management application were discussed as well as the frames applied in order to achieve success. Most of the participants referred to the weekly meetings and the monitoring and control processes to follow-up on the progress and the good project management practices application.

> ... a bi-weekly meeting is so important for monitoring and follow-up on the project ... we discuss the progress ... and what are the actual problems happening or the potential problems that may arise. We try to find solutions in these meetings and actions are taken to solve problems. (I4)

I7 also mentioned the computer programs that aim to help achieve better planning and monitoring.

> ... PMP and PROP-C who help ... since the initial phases till the hand-over... For example, budget: at the analysis phase, it is budget planning, during establishment phase, you do budget follow-up and check what is your current cost. The whole idea is to do the follow-up on these factors ... because these tools are not helping the success of the project but they are making the project better planned and organised ... (I7)

External personnel were also said to impact on project success and human resource management. Specifically executive support, coordination and stakeholders' management were highlighted by the research participants:

> Sometimes a good relation with other stakeholders on the project, could make things easier for you ... When the relationship is in good shape, it will increase the connection needed on the project by creating a network society. This can benefit you in the execution phase of the project, because when you need any support or help, you will get it easier (I7).

> …if you have good management to deal with budget issues and get the money on time and ... for the project financing ... to have funds with no delays in order not to delay the project (I4).

> …if the project is not successful, it will also affect your satisfaction because it will give you negative vibes ... I need to have all the stakeholders satisfied (I1).

> ... project management require lots of coordination and cooperation with different stakeholders like contractors, engineers and other... but ... in project management

> processes there is a way like escalating to the owner, the investors or the stakeholders to remove any problems or hurdles within the project (I6).

DISCUSSION

Within the Lebanese real estate context project finance, time management and human resource management emerge as central to project management practice. Arguably, the same aspects of management are at the heart of project management everywhere (Project management Institute, 2013). Although all of our respondents explicitly note that Lebanon is different, as we show above, our analysis reveals rather more similarities with best practice than contextual differences in terms of project management practice.

As noted earlier, academic literature on project management is divided between the best practice school of thought and the contextual approach. The multidimensional stakeholder approach allows us to contribute towards this debate by considering the three levels of project management: the macro, meso and micro. Such a view allows us to extend our understanding of the similarities/ differences between stakeholders and helps us locate support for the best practice and/ or contextual approaches within the three levels.

Not surprisingly, those interviewees that we had identified as respondents who might offer us the strategic view at the macro level (I2, I3 and I5) very much focused on discussing big issues like financing at the sector/ country level (rather than specific project finance like those respondents who we had identified as relevant for discussing the micro level concerns). Many of these issues emerged as specific to Lebanon and the position of Lebanon within the geographical region, e.g. facilities offered by the Central Bank of Lebanon and the sense of belonging within the Lebanese expatriate community. Also, the relative stability afforded within otherwise uncertain geographical area was a clear benefit to Lebanon as a country and its real estate sector. This indicates that the respondents adopt a contextualised approach to project management at strategic level.

At the micro level our respondents (I1 and I4) focused more on processes, like recruitment and selection in ensuring appropriate project staffing, and monitoring and controlling project progress and delivery. This view supports the best practice approach. However, respondents I1 and I4 also considered the contribution of specific individuals to managing projects and placed heavy responsibility on key personnel and charismatic managers in achieving favourable outcomes. One example that was highlighted related to motivating operatives and staff to work overtime. Interviewee (I1) explicitly notes that such a situation was special to Lebanon, yet project management literature informs us that in fact overtime and the challenge of motivating construction/ real estate workforce is universal (see for example Project Management Institite, 2013). Thus, at the micro level we found some support for the contextualised approach but considerably more support for best practice.

Our respondents at the meso level (I6 and I7) also tended to lend support towards the best practice model discussing communications and co-ordination, policies and procedures, inspections and other monitoring and control mechanisms. Their view was broader and reached out of the direct project context to include a wider range of project stakeholders. Some responses from I7 specifically related to the contextualised approach, e.g. consideration of company reputation.

One explanation for such a difference in between the three levels of respondents may be their training and background. At the strategic level we do not know that any of our respondents would have had any project management related training. At the micro level however the interviewees were certified project managers and this may be why they were oriented towards best practice. Project management training, development, and accreditation and certification programmes generally seek to "kit out" or "tool up" project managers with the right skills and competences to manage projects. Such training is often more closely aligned towards the best practice model (see for example PRINCE2: www.prince2.com).

CONCLUSION

This research offers a contribution towards developing an understanding of project management practice specifically within the context of Lebanese real estate sector. Project financing, time management and human resource management have been highlighted through the analysis of a small set of qualitative data. We discuss how the views of our respondents at different levels (macro, meso and micro) align with the best practice and/ or contextual approach to project management. Given the limitations regarding generalisability of our findings and in order to investigate more deeply the project management practice in real estate projects in Lebanon, the next stage of the study will employ a mixed-methods approach to developing a success measurement framework that accounts for the practice and success criteria in the Lebanese market through a larger scale mixed-method programme of research.

REFERENCES

Amideast (2016) *Certified Associate in Project Management*. Available at: http://www.amideast.org/lebanon/professional-development/certified-associate-project-management [Accessed 23 June 2016].

Akintoye, A, McIntosh, G and Fitzgerald, E (2000) A survey of supply chain collaboration and management in the UK construction industry. *European Journal of Purchasing and Supply Management*, **6**(3), 159-168.

Association of Banks of Lebanon (2010) *Monthly Article, June-July 2010.* Available at: http://www.abl.org.lb/ar/subpage.aspx?pageid=1089 [Accessed 01 May 2015].

Bazeley, P (2013) *Qualitative Data Analysis: Practical Strategies*, Thousand Oaks, CA: Sage Publications.

Byblos Bank (2015) *The Economy: Byblos Country Risk Weekly Bulletin*. Issue 35, July 2015.

Bresner, C and Hobbs, B (2008) Project management practice, generic or contextual: A reality check. *Project Management Journal*, **39**(1), 16–33.

Besner, C and Hobbs, B (2013) Contextualized project management practice: A cluster analysis of practices and best practices. *Project Management Journal*, **44**(1), 17-34.

Bryman, A and Bell, E (2015) *Business Research Methods 4th Edition*, Oxford: Oxford University Press.

Dvir, D, Raz, T and Shenhar, A J (2003) An empirical analysis of the relationship between project planning and project success. *International Journal of Project Management*, **21**(2), 89-95.

Görög, M (2012) Beyond the myth of best practice in project management. *Dynamic Relationships Management Journal*, **1**(1), 60-72.

International Monetary Fund (2010) *Staff Report for the 2010 Article IV Consultation, 2010*

Johnson, P and Duberley, J (2000) *Understanding Management Research*, London: Sage Publications.

Kerzner, H.R (2014) *Project Management Best Practices: Achieving Global Excellence*. Hoboken, NJ: John Wiley and Sons.

Kloppenborg, T J and Opfer, W A (2002) The current state of project management research: Trends, interpretations, and predictions. *Project Management Journal*, **33**(2), 5-18.

Mchugh, O and Hogan, M (2011) Investigating the rationale for adopting an internationally-recognised project management methodology in Ireland: The view of the project manager. *International Journal of Project Management*, **29**(5), 637-646.

Nash, M (2014) *Empty Towers*. Executive Magazine, December 2014 Available at: http://www.executive-magazine.com/business-finance/real-estate/empty-towers [Accessed 02 February 2015].

Nash, M (2014) *The Slump Begins To Hurt*. Executive Magazine, December 2014 Available at: http://www.executive-magazine.com/business-finance/real-estate/slump-begins-hurt [Accessed 02 February 2015].

Nicolini, D (2002) In search of 'project chemistry'. *Construction Management and Economics*, **20**(2), 167-177.

Project Management Institute (2013) *A Guide to the Project Management Body of Knowledge (PMBOK Guide) 5th Edition*. Pennsylvania: Project Management Institute.

White, A (2015) *The Next Global Property Hotspot? Why, Beirut of Course*. The Telegraph, March 2015 Available at: http://www.telegraph.co.uk/finance/property/international/11456649/The-next-global-property-hotspot-Why-Beirut-of-course.html [Accessed 20 March 2015].

White, D and Fortune, C (2002) Current practice in project management: An empirical study. *International Journal of Project Management*, **20**(1), 1–11.

Yerevanian, C (2014) *The Slump Begins To Hurt*. Interview by Matt Nash for Executive Magazine, December 2014 Available at: http://www.executive-magazine.com/business-finance/real-estate/slump-begins-hurt [Accessed 02 February 2015].

PRIVATE SECTOR PARTICIPATION IN NIGERIA HIGHER EDUCATION INFRASTRUCTURE DEVELOPMENT

Adebusola Ateloye[1], Graeme Bowles and Adekunle Oyegoke

Centre of Excellence in Sustainable Building Design, School of Energy, Geoscience, Infrastructure and Society, Heriot-Watt University, Edinburgh, EH14 4AS, UK

Public private partnership (PPP) procurement route was introduced with the aim of increasing the capacity and quality of public services across the globe, whilst the PPP sector is now established and mature in many countries, realising the objectives of PPP has eluded many countries in Sub-Saharan Africa including Nigeria where the level of private sector participation in infrastructure provision remains low particularly in the Higher Education Infrastructure (HEI) sector. This study aims at exploring reasons for low participation, by evaluating the challenges associated with PPP procurement system in Nigeria HEI sector. Semi-structured interviews were conducted with stakeholders, the gathered data was analysed using thematic framework analysis and the result indicate that the private sector is reluctant to engage in partnerships with the public sector owing to stakeholders' challenges, integrity issues, as well as governance challenges. The study concludes that increased transparency and accountability in the tendering procedures will enhance the potentials of PPP in the HEI sector, and recommends that governance systems and procedures that minimise corruption and mistrust should be put in place.

Keywords: governance, higher education, partnering, procurement, stakeholders

INTRODUCTION

In recent years, improved service delivery has been high on the agenda of many governments all over the world, this is because most governments do not have sufficient funds to meet up with public demands for innovative and improved service delivery. Consequently, they have resorted to partnering with the private sector in order to meet these demands. Amongst many partnerships arrangements available, the public private partnership (PPP) seems to be the most convenient collaborative arrangements for most developing Nations. PPP is said to be a cooperative venture between the public and private sectors (Grimsey and Lewis 2004) formed from the combination of the resource capacity and expertise of each sector, in order to provide a stronger base for delivering public services in a better, more efficient and effective manner.

It is one of the many other innovative procurement strategies introduced to complement or replace the traditional open competitive tendering route as the case maybe (Ahadzi and Bowles 2001). PPP allow assets financing especially when a particular government is not able to finance the needed facilities; in other words, it

[1] asa96@hw.ac.uk

Ateloye, A, Bowles, G and Oyegoke, A (2016) Private Sector Participation in Nigeria Higher Education Infrastructure Development. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 921-929.

offers alternative source of financing for improved public service delivery and or new infrastructure development. (Li *et al*., 2005). The main incentives for adopters of PPP are; (i) risks are allocated to the parties whom it is best fit, and (ii) projects are delivered on time and to cost. In addition, contractors are engaged early in the design stage thereby giving room for innovation in design and construction ideas.

Consequently, Nigeria government like other governments in other parts of the world have turned to PPP for the provision of infrastructures to enhance service delivery to the people. Some of the sectors which have benefited include transportation, power, and education. However, the level of private sector participation in the delivery of higher education Infrastructure (HEI) in Nigeria is evidently low as reported in a study carried out by Thomas and Thomas in 2013. Previous studies (Thomas and Thomas 2013), showed that there is the need to boost private sector participation in the HEI sector.

The main thrust of this study however is to examine achievements of PPP in other sectors of the Nigerian economy as earlier outlined with a view to understanding how it can be replicated in the Nigeria's public tertiary institutions' infrastructure which are already in a sorry state. In particular, this study seeks answers to this question; how can the Nigerian government enhance the participation of the private sector in the delivery of Higher Education infrastructure? The study will further explore reasons for low private sector participation in HEI; by evaluating the challenges associated with PPP procurement process in Nigeria. The study was conducted through the examination of relevant literature, followed by field investigation.

PUBLIC PRIVATE PARTNERSHIP IN NIGERIA HEI SECTOR

Recently, the Nigerian government put in place some reforms for private sector participation in the development of the education sector. These reforms are Public-Private Partnership Initiative (PPPI), Adopt - a - School, Community Accountability and Transparency Initiative (CATI), Private Development Initiative (PDI) and Higher Education Collaboration (HEC) to mention but a few. According to Thomas and Thomas (2013), these reforms have not made any significant difference in the sector, and however acknowledged a knowledge gap in understanding the reasons behind private sector's reluctance to partner with government and recommended research into the factors that are restraining the private sector in the development of higher education infrastructure in Nigeria. The literature review conducted also exposed the fact that PPP is not new in Nigeria HEI sector, however it is mostly seen in the area of economic infrastructures such as students' hostels, but not in the area of providing academic buildings such as laboratories, libraries etc.

Furthermore, in order to achieve suitable legal and regulatory environment for PPP projects in Nigeria, the Federal Government of Nigeria passed the Infrastructure Concession Commission Act (ICRC Act 2005) which acts as the legal framework guiding private participation in public services. There are also sector specific agencies and laws that regulate the services. For instance, the ICRC Act regulates the participation of the private sector in financing, construction, development, operation, and maintenance of Federal Government infrastructure through concession or contractual arrangements. ICRC is also responsible for setting out guidelines to promote, facilitate and ensure implementation of (PPP) Projects in Nigeria with the objective of achieving better value for money (VFM) for infrastructure services and enhanced economic growth. Notwithstanding the existence of the ICRC Act and PPP legal framework, Nigeria still faces diverse challenges in the process of partnering.

Some of these challenges are as a result of poor planning, and inappropriate political involvement.

RESEARCH METHODOLOGY AND METHOD

Qualitative research approach was deemed fit for the study because the desired data require a better understanding of the strategic issues in the HEI sector; seeing the true situation through the eyes of the stakeholders (Bryman 2012). Qualitative research method uses inductive reasoning, does not support natural science and positivism and views social research as subjective and continually changing (Bryman 2012). This study stands on interpretivism epistemological idea; which believes that the social world should not be studied in the same manner and procedures as it is done with natural sciences. This research was set to study the social world, people as well as institutions and therefore different from the study of natural sciences. On the ontological point of view; the study stands on constructivism, in which social entities and their meaning are not independent of social actor. Data was collected through semi-structured interview. Saunders *et al*., (2012) opined that semi-structured interview is most suitable for an investigatory study, thereby giving opportunity to probe the participants further. This method does not need any predefined questions but the researcher must have clear understanding and view of the aspect to explore during the course of the interview (Saunders *et al*., 2012).

Interview: Semi structured interview

According to Bryman (2012), interview is a strategy by which data is collected during both quantitative and qualitative research. This exploratory study is interested in the participants' views, with rich detailed answers. There is therefore the need for flexibility and flexibility in research interview can be achieved through semi structured and unstructured interview (Bryman 2012), hence semi-structured interview was identified as most suitable method of data collection for this study, the participants who are the stakeholders were allowed to speak freely while answering open ended questions. Semi-structured interview does not require a set interview questions (Saunders *et al*., 2012) rather an order by which the topics would be treated, this served as guide for the interviewer (Saunders *et al*., 2012, Bryman 2012).

Sample Recruitment

Stakeholders of PPP and HEI sectors in Nigeria were identified from literatures reviewed, the participants were recruited purposively using research question as the basis for recruiting them. Purposive sampling is referred to as a non-probability form of sampling in which research participants are not sampled randomly but are sampled purposefully so that the recruited participants are relevant to the research question to be answered (Bryman 2012), it does not allow for generalisation of a population but the research question dictates the participants (Bryman 2012). Stakeholders who are deemed relevant to this study were contacted, some of them were then able to introduce other stakeholders, who were thereafter contacted, this is a form of snowball sampling; a type of purposive sampling identified by Bryman (2012). The respondents are shown in table 1 below. The identified stakeholders were grouped into four (4): (i) higher institutions (end users), (ii) Federal government agencies (governing bodies overseeing all the activities of the higher institutions), (iii) Private sector (private developers) and (iv) Funding bodies (commercial banks).

Table 1: List of respondents

S/No	Organisation	Department	Designation	Research Instrument	Interview Date	Interview Duration
1	University of Lagos	Department of Works and Physical Planning	Director	E-mail	Responded on 03/07/15	Not applicable
2	Obafemi Awolowo University	Physical Planning and Development Unit.	Director	Telephone	25/05/15	55mins
3	University of Abuja	Department of Physical development	Director	Telephone	28/05/15	35mins
4	Obafemi Awolowo University	Project Implementation Committee	Chairman	Telephone	18/05/15	70mins
5	Federal Ministry of Education (FME)	Department of Tertiary Education	Director	Telephone	19/08/15	40mins
6	Bridgup Nig Ltd	Administration	MD/CEO	Skype	02/09/15	48mins
7	Researcher in the field	Heriot-Watt University	Lecturer	Face to Face	04/05/15	65mins
8	Researcher in the field	Obafemi Awolowo University	Lecturer	Skype	23/05/15	80mins

DATA COLLECTION AND ANALYSIS

Data was collected via semi-structured interviews, which gave opportunities for flexible open ended answers. The interviews took between 25 and 80 minutes; all the interviews were conducted between May and September, 2015. In total 8 stakeholders were interviewed, four (4) of which were interviewed via telephone, one (2) via skype, one (1) face to face and one (1) preferred that the questions be e-mailed, which was answered and sent back via e-mail. All the participants are over 40 years of age, have over ten (10) years' experience and hold at least a degree which qualified them to be considered to have sufficient knowledge in this area of research. Prior to the interviews, introductory e-mails we sent to the participants with brief narration of the research and further followed up with telephone calls.

Different approaches were considered for the analysis of the research data, thematic framework analysis was considered suitable for the purpose of this study; thematic framework analysis is a matrix-based method of ordering and synthesising data (Ritchie *et al*., 2013), this approach was developed on the basis of conducting applied qualitative research at the National Centre for Social Research in the United Kingdom (Ritchie and Lewis 2003, Bryman 2012). The data was therefore analysed in accordance with the five stages of thematic framework analysis; familiarisation, identifying a thematic framework, indexing and sorting, charting and mapping/interpretation.

The data was typed out and transferred into NVivo; NVivo is computer-aided qualitative data analysis software (CAQDAS) which is designed to help researchers in the analysis of qualitative data (Bryman 2012). All the interview responses were then

read through again and again to have a grasp of the full content of the data, this is the familiarisation process; the idea behind familiarisation is for the researcher to become conversant with the research data before the process of sifting and sorting (Ritchie and Lewis 2003, Ritchie *et al*. 2013). In the process of familiarisation, a set of themes were identified based on the content of the research data which is inductive in nature, the themes are the issues raised by the respondents which formed the thematic framework within which the research data were sorted as posited by Ritchie and Lewis (2003).

The identified themes were entered into NVivo as Nodes, followed by sorting and coding the research data into same nodes (themes) which they relate to. The process of doing this is referred to as indexing in framework analysis (Ritchie *et al*., 2013). The codes which are relevant to the research question were organised into categories of themes. After the process of sorting and indexing of the research data into different nodes in NVivo, a matrix was created for each of the themes by charting the research data for each case and code within the themes and hierarchical arrangements as well as into sub-themes this forms the thematic framework. At this stage of the work, coded data were reviewed to be sure that they were properly coded and also to see if there are any more left out. The connections between the codes were also reviewed; some sub themes were also identified, table 2 below shows the identified themes and sub-themes.

Table 2: Identified themes and sub-themes

Themes	Sub Theme
Governance	Transparency
	Corruption
	Autonomy
	Funding
Stakeholders	Inexperience
	Opposition

FINDINGS

In order to determine the reason for low participation of the private sector in the HEI sector, the views of the stakeholders were examined and the findings corroborated what had been identified in the reviewed literature. It was noted some institutions have been able to partner with the private sector in the area of providing student accommodation using Build Operate Transfer (BOT) model of PPP; examples are 400 bed space capacity student hostel for the University of Lagos, University village at the Obafemi Awolowo University Ile Ife, where about 16 developers have partnered with the institution to provide student accommodation ranging from 100 to 400 bed spaces using BOT Model. However, some respondents opined that inability of both government and the private to adhere to the terms and conditions of the agreement which usually result to conflicts is the major challenge faced by this particular procurement route in Nigeria. PPP is termed risk transferring cooperation between the government and the private sector; if this cooperation is not well managed then the desired success will not be achieved (Vries and Yehoue 2013).

Governance

According to Bevir (2012) governance can be referred to all processes of governing either formal or informal and PPP projects are said to be a sub-set of the tools of government i.e. institutional arrangement through which public policy is mediated (Hodge *et al*., 2010), therefore suitable governance mechanism should be designed in such a way that the interest of the public will be properly protected (Hodge *et al*. 2010). Most participants advocated for good governance, some of the participants question the efficiency of Infrastructure Concession Regulatory Commission (ICRC); the agency which is in charge of all PPP projects in Nigeria. Participants advocated for proper monitoring process, and robust institutional/legal framework. The process of awarding contracts and going into partnerships are judged not transparent and should be looked into in order for the PPP to be successful in the country. Hodge *et al*., (2010) opined that PPP usually comes in different number of legal forms which all have implication in allocating roles and responsibilities between all the parties that are involved in the PPP arrangement. Whichever legal form a PPP arrangement takes will depends largely on the legislative framework (Hodge *et al*., 2010 Vries and Yehoue 2013).

Transparency

This study finds that the inability of the government to be transparent enough in the process of project award is one of the reasons why the private is not keen in partnering with the government to provide infrastructure. UNECE (2004) advocated the need for fairness in the process of awarding contracts with clear goals which can easily be measured. Government has to be transparent in the procurement process, the selection processes, shun corruption and take into account the interests of the stakeholders (UNECE 2004). In undertaking a PPP project, there is a need for the government to know whether the PPP project will achieve Value for Money (VMF), with the goals of the project clearly defined (UNECE 2008). Government should also make sure that the procurement procedures are followed to the later.

> PPP is a good initiative but if parties could be honest with themselves, I think it can pull through

Corruption

Corruption is also seen as one of the challenges PPP projects are currently faced in the country; the participants posit that if corruption is reduced to the minimum, PPP will thrive in Nigeria. Vries and Yehoue (2013) opined that it is important to fight corruption in order to achieve functional public services, the effect of corruption in the three stages of a construction project; namely, decision, tender, and execution stages can greatly affect the success of a PPP project. At the design stage a corrupt officer could decide to execute a project based on his or her interest (Hodge *et al*., 2010) and most times the cost of public services are unnecessarily increased as a result of corruption (Vries and Yehoue 2013).

Funding

It was gathered from the study that government is the major financier of Higher Education in Nigeria; most of the funds are received annually from the Federal Government through the appropriate Ministry, Department and Agencies (MDA) that are in charge of all levels of education and Universities; Federal Ministry of Education and National University Commission respectively. The amount of funding made available to these institutions are not adequate and therefore cannot allow proper provision of infrastructure. The participants opined that funding is the major

challenge; this problem ranges from inadequate funding to mismanagement of the available funds. PPP procurement route is also limited by the inability of the developers to access funds, some private developers are not able to access proper funding, while some who are already into partnerships are not able to complete on-going projects as at when due for completion. Apart from inadequate funding, the institutions themselves misappropriate the available funds, where the available funds are used in providing infrastructures which are not crucial, by not prioritizing the needs of the institutions.

Autonomy

The fact that the institutions do not have total autonomy to be able to partner with the identified private organisations is said to be a problem in the partnership arrangement. There is therefore the need for the individual institutions to have a degree of autonomy in order to be able to reach out to potential partners.

> There is the need for university autonomy, in order for them to work; a level of autonomy is needed. Universities should be free to reach out to partners

Stakeholders

A stakeholder is anyone who can be affected or can influence the achievement of an organisation (Chinyio and Olomolaiye 2010), and their views differ from each other's view (Chinyio and Olomolaiye 2010), the ability to achieve proper stakeholder management is said to be crucial to the success of any PPP project (El-Gohary *et al*. 2006). Nigeria PPP stakeholders have very low experience in the area of PPP procurement system; the participants stated the need to properly educate the stakeholders on PPP procurement method, and also the need to carry along important stakeholders throughout the process of procurement. This is because stakeholders of a construction project are as important as much as the clients of the projects (El-Gohary *et al*. 2006), such as the users, customers and members of the community etc.

Government has already started training staff on PPP procurement method as stated by one of the participants. Stakeholder's opposition is another problem such projects usually face in Nigeria, this is evident in the Lekki Road project in Lagos Nigeria, the community, passengers and commercial drivers were not willing to pay toll as a result charged the Lagos state government to court, in cases like this, ability to address the imputes of the stakeholders of a PPP project is very important for the Project to be successful (El-Gohary *et al*., 2006), these are some of the reason why El-Gohary *et al*., (2006) opined how important it is to gauge the opinion and the interests of stakeholders in the development of PPP projects that relates to their needs.

DISCUSSIONS

One of the main challenges identified through the analysis of the data is the problem of governance system of PPP in Nigeria. The structures by which PPP projects are set up, coordinated and ran is termed the governance, this includes the process of making decision (van den Hurk and Verhoest 2015). Governance is also said to be a practice undertaken by human beings who are guarded by power, positions and perceptions (Chhotray and Stoker 2009), these practices are political activities, decision-making which are most times dependant on personal interests (Chhotray and Stoker 2009). PPP as cooperation between the government and the private sector, involves the sharing of risk between the two parties, therefore there is need for PPP governance to be properly examined because of the complexities of PPP projects and the partnership itself (van den Hurk and Verhoest, 2015).

The other identified problem is the stakeholders; the inability to properly manage the relationships of the PPP project stakeholders, the fact that they are not usually properly been involved is the major reason for stakeholder resentment. El-Gohary *et al*., (2006) opined that the opposition of the public as a result of different factors were reported as the major reason for the failure of several PPP projects, there is the need to ensure proper stakeholder involvement in the process of PPP procurement (El-Gohary *et al*., 2006), starting from the planning/design phase as well as the construction phase (El-Gohary *et al*., 2006).

Stakeholders of a construction projects are interrelated to each other, either formally or informally, while the clients, and contractors of a construction projects are linked through legal contracts (Chinyio and Olomolaiye 2010). Also, stakeholders could have both positive and negative influence on construction project throughout the duration of a project (Olander 2007), the general perception of stakeholders of a construction project usually affect the outcome of the project either positively or negatively (Olander 2007). It was also gathered that the private sector is not keen to invest in projects that cannot yield returns commensurate with the level of risk, hence the lack of interest in social infrastructure such as higher education infrastructure when compared with other sectors of the economy. Therefore, there is the need for Nigeria government to address the issue of profit and risk in order to achieve success in higher education PPP projects.

CONCLUSIONS

According to UNECE (2008), there are six widely accepted core principles of good governance in PPP; participation; which is the level of participation of the stakeholders, decency; adhering strictly to the rules and regulations of the process, transparency; clarity and openness in the process of making decisions, accountability, fairness, and efficiency. All these are said to be closely linked to each other (UNECE, 2004), the literature review conducted revealed that these six principles are lacking in the Nigeria PPP procurement process. (UNECE, 2008) opined that good governance in PPP will no doubt yield economic benefits, and further advocate the integration of the following into the practice of PPP; participation, decency, transparency, accountability, fairness, efficiency and sustainable development. Following the literature review carried out as well as the investigatory survey conducted, how then has Nigeria PPP performed using the six identified core principles of good governance in PPP? It could be concluded that Nigeria PPP has not performed well enough to be compared with the international best practice of good governance of PPP.

The study concludes that the private sector is reluctant to engage in partnerships with the public sector owing to stakeholders’ challenges such as stakeholders' inexperience and opposition, integrity issues; as well as governance system. The study recommends increased transparency and accountability in the tendering procedures will enhance the potentials of PPP in HEI sector, governance systems and procedures that minimise corruption and mistrust should also be put in place. For a successful PPP project, there should be proper stakeholders' engagement, as well as good project governance.

REFERENCES

Ahadzi, M and Bowles, G The private finance initiative: the procurement process in perspective. *In*: A Akintoye (Ed.) *Proceedings 17th Annual ARCOM Conference*, 5-7 September 2001, Salford, UK. Association of Researchers in Construction Management, Vol. 1, 991-999.

Bevir, M (2012) *Governance: A Very Short Introduction*. Oxford, Oxford University Press.

Bryman, A (2012) *Social Research Methods.* Oxford: Oxford University Press.

Chhotray, V and Stoker, G (2009) *Governance Theory and Practice: A Cross-Disciplinary Approach*. Basingstoke, UK: Palgrave Macmillan.

Chinyio, E and Olomolaiye, P (2010) Introducing stakeholder management. *In*: E Chinyio and P Olomolaiye (Eds.) *Construction Stakeholder Management*. Chichester, West Sussex: Wiley-Blackwell.

El-Gohary, N M, Osman, H and El-Diraby, T E (2006) Stakeholder management for public private partnerships. *International Journal of Project Management*, **24**(7), 595-604.

Grimsey, D and Lewis, M (2004) *Public Private Partnerships: The Worldwide Revolution in Infrastructure Provision and Project Finance*. Cheltenham: Edward Elgar Publishing.

Hodge, G A, Greve, C and Boardman, A E (2010) *International Handbook on Public Private Partnerships*. Cheltenham: Edward Elgar Publishing.

Li, B, Akintoye, A, Edwards, P J and Hardcastle, C (2005) Critical success factors for PPP/PFI projects in the UK construction industry. *Construction Management and Economics*, **23**(5), 459-471.

Olander, S (2007) Stakeholder impact analysis in construction project management. *Construction Management and Economics*, **25**(3), 277-287.

Ritchie, J and Lewis, J (2003) *Qualitative Research Practice: A Guide for Social Science Students and Researchers*. London, Sage Publications.

Saunders, M, Lewis, P, and Thornhill, A (2012) Research Methods For Business Students. Harlow, Essex: Pearson.

Thomas, O and Thomas-Olufuwa, A (2013) Public-Private Partnership and Management of Higher Education in Nigeria. *Journal of Educational Review*, **6**(1), 109-117.

United Nations Economic Commission for Europe (2004) *Governance in Public Private Partnerships for Infrastructure Development*. Geneva: United Nations Economic Commission for Europe.

United Nations Economic Commission for Europe (2008) *Guidebook on Promoting Good Governance in Public-Private Partnerships.* Geneva: United Nations Economic Commission for Europe.

Van Den Hurk, M and Verhoest, K (2015) The governance of public-private partnerships in sports infrastructure: Interfering complexities in Belgium. *JPMA International Journal of Project Management*, **33**(1), 201-211.

Vries, P D and Yehoue, E B (2013) *The Routledge Companion To Public-Private Partnerships*. Abingdon, Oxon: Routledge.

CHALLENGES FOR IMPLEMENTING PUBLIC PRIVATE PARTNERSHIP IN HOUSING PROJECTS IN DAR ES SALAAM CITY, TANZANIA

Neema Kavishe[1] and Min An

School of Civil Engineering, the University of Birmingham, Birmingham B15 2TT, UK

Despite the absence of a PPP legal framework Tanzania has adopted PPP in a few sectors including the housing sector. For a number of years the country has been facing a severe shortage of adequate housing. The government advised its housing agencies to adopt PPP strategies in order to deliver more adequate houses, yet the deficiency remains high and progress is slow. Therefore the objective of this paper is to identify major challenges hindering HPPP in Tanzania. A questionnaire survey and interviews were used to collect data. The sample was purposely selected whereby a total of 28 responses and 13 interviewees were obtained, which were analysed using descriptive and inferential statistics. The study discovered that the partnership opportunity in the housing sector has been unsuccessful and is being abused because of the lack of partnership skills as well as inadequate policies among other factors. Despite the failures experienced, PPP is still considered a viable arrangement if PPP principles and customized framework models are adopted. Therefore since this paper is part of the ongoing research, the next stage will use the findings obtained to develop and propose a PPP process model that will guide the projects in order to address the identified challenges.

Keywords: challenges, housing project, public private partnership, PPP, Tanzania

INTRODUCTION

Tanzania lacks suitable policies for housing development and this has largely contributed to the growth of squatters and poor housing conditions. Since Independence the country has experienced a large increase in population which has strained the available social facilities and services. According to IGC, (2014) in 1967 the total population was 12.3million, and by 2012 the population grew to 44.9 million. Similarly the urban population increased from 5.7% in 1967 to 29.1% in 2012. Looking at the trend the population growth averaged nearly 3% annually while urbanization grew by 5% annually. Dar Es Salaam the study area, the capital city with a land area of 1350 Km square, holds 10% of the country's population while 70% of its residents live in informal settlements (Kidata 2013). The consequence of the rapid growth of population has strained the available social facilities such as housing where the low income group are the most affected. The current housing shortage in Tanzania has been estimated at 3 million housing units while the rate is growing to 200,000 units per annum (NHC, 2010). As a result of this widening gap the government had to seek alternative means of addressing this issue and the Public Private Partnership (PPP) strategy is thought to help bring relief to the existing

[1] nwk385@bham.ac.uk

Kavishe, N and An, M (2016) Challenges for Implementing Public Private Partnership in Housing Projects in Dar es Salaam City, Tanzania. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference,* 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 931-940.

situation (Kidata 2013; NHC 2010). Despite the adoption of PPP in house delivery, the problem has not yet been solved and instead more high cost houses are being built. Therefore this paper seeks to identify the challenges hindering the growth and success of PPP in the delivery of housing in Tanzania.

PPP Housing in Tanzania

Housing PPP (HPPP) is still at its early stages in Tanzania primarily because of lack of direct experience and inadequate new investment in housing projects. So far two public organizations, the National Housing Corporation (NHC) and the National Social Security Fund (NSSF) have used the PPP method in housing provision. Since 1990s NHC used the PPP approach in building development but most of its partnership projects were not very successful. The lack of an adequate PPP legal framework to guide the implementation of such projects delayed its progression (URT 2009). According to Kavishe (2010), NHC PPP approach to housing projects was used in a form of Build Own Operate (BOO) and the Build Operate Transfer (BOT) model. It was assumed that a period of 12 years was adequate for investors to recoup their capital invested in projects, given the present and future outlook of the real estate market in Tanzania. This time frame was stipulated for all projects irrespective of the size and nature of the project and was stipulated in NHC JV Policy (2006) Article 4.2.51. Thereafter for BOT projects the property was to be transferred fully to the public partner.

The policy loopholes and flaws led to failure of some of these projects. For example the policy stipulated that NHC's contribution was limited to the project land, which accounts for 25% of the project shares. However, partners financing the projects fully to completion had their share account for 75%. Unfortunately, valuation of land was not employed in determining NHC shares in Joint Venture (JV) projects. However the 75:25 ratio applied to all projects regardless of the magnitude and locality of the project. Also NHC was entitled to hold a 50% share in projects requiring big cash outlays, which NHC could not afford to finance. The policy provided for NHC to start with minority shares of not less than 25% but had the right to acquire another 25% after a period of 12 years. However it was discovered that some contracts stated that at the end of the 12th year if NHC fails to increase its share to 50% then the property will be fully owned by the private partner. Most investors benefited from this clause since NHC was not capable of increasing its share within the stipulated time because of its poor financial situation.

Similarly in their very early projects the selection of their partner was in the manner of first come first served. There was no room for competition, which would have assisted the Corporation to secure more potential investors. Its desperateness resulted from lack of funds and the fear of loss of some of their plots and properties that had been declared by the Ministry of Land ripe for redevelopment. Also in 1992, the Government issued Circular No. 1 which required public parastatals to operate commercially. Consequently, no further subsidy was given to NHC. Therefore, the above reasons stirred NHC to adopt partnership strategies as a means of redeveloping its estate. They focused on more commercial buildings and fewer residential buildings, and some of the buildings were shop-houses where the ground floors were meant to be shops and upper floors were living spaces. Unlike NHC, private developers were motivated to partner with NHC because holding land in prime areas and having the Right of Occupancy in prime location like the Central Business Districts (CBD) of big cities facilitated them to secure loans more easily. On the other

hand, rental charges in prime areas were higher and more competitive than in the peripheral areas.

Due to this many investors preferred the partnership approach and a majority opted to invest only in the city centres to maximise profit. Financial assessment of private partners was not undertaken to any real degree because of corruption. As a result a number of investors were facing financial difficulties a few months after the start of the project which led to delays, poor performance and unsuccessful delivery of the projects. Such critical failures alerted the NHC to stop further partnership projects and had to work on solving disputes and project irregularities. On the government side there have been serious efforts to improve and promote private sector participation in PPP projects. This culminated in first a PPP Policy, then a PPP Act in 2010 and finally in 2011 PPP Regulations being approved. A PPP Coordination Unit was established by the 2010 PPP Act within the Tanzania Investment Centre (TIC) to coordinate and oversee the mainland Tanzanian PPP projects and PPP Financing Unit within the Ministry of Finance with the duty of assessing and examining all PPP proposals in their financial aspects.

Despite the establishment of these units none of the HPPP projects passed through them for assessment and approval. New projects such as the Dege Eco Village, procured after their establishment were not submitted into these units for approval. This was confirmed by the head of the PPP finance unit and the project managers. Having suitable PPP strategies, policies and regulatory framework is one thing, but making them effective and efficient is another.

The other public organization involved in HPPP provision, NSSF, has one large project known as Dege Eco Village located in Kigamboni Dar Es Salaam. It is a recent project developed by Hifadhi Builders Limited, a joint venture between NSSF (public partner) and Azimio Housing Estate (private partner). According to the former Director General the project will be implemented in three phases; scheduled for completion by end of 2016, 2017 and 2018 respectively. He stated that, it is part of its ongoing initiative to provide decent affordable housing in the country. However it was not made clear for which income group these are intended to be affordable because even the price of the cheapest unit in that project is unaffordable for both medium and low income earners. A total of 7,160 apartments and 300 villas will be constructed using Tunnel moulding system (concrete technology) from Turkey in order to allow speedy erection and mass construction. The Partner selection was not competitive because it was an unsolicited proposal. The private partner provided 300 acres of land which is equivalent to 20% of the project value and equity of up to 35% amounting to 55% while NSSF will provide an equity share of 45%. So far this project is still under construction.

LITERATURE REVIEW

According to Moskalyk (2011) both the public and private sectors are adopting partnerships for the delivery of housing and urban development worldwide. Developed countries such as the UK, Canada, the USA, Australia and some other developing countries such as India, Nigeria, South Africa and Malaysia have employed PPP projects in delivering affordable houses (Moskalyk 2011; Abdullahi and Aziz 2011; Liu, Chan *et al*., 2014). These countries have experienced challenges some of which are unique and some are similar. For example a study by Trangkanont and Charoenngam (2014) supports that, "A number of developing countries such as Thailand, Vietnam, the Philippines, Malaysia and Indonesia have experienced failures

in their PPP Low-Cost Housing (PLCH) projects due to different factors". Trangkanont and Charoenngam identified ten failure factors of PLCH in Thailand. These were "inadequate tender documents", "inefficient Management Change", "poor contractors", "political intervention", "ineffective PPP policy and strategy", "weakened institutional culture", "policy pressure", "difficulties to low income group", "economic problems" and "Housing Finance constrains". Furthermore the above study indicated that the identification of the failure factors is useful for both policy makers and operational practitioners because it provide a basis for preparing a strategic risk management framework.

Another study conducted by Sengupta (2006) highlighted a number of constraints to PPP housing projects in Kolkata that include; "poor access to finance by low income families", "out dated legislation", "high levels of municipal taxes", "stamp duties" and "sanction fees". But despite the challenges Kolkata has been successful in adopting PPP in housing in terms of cost and quality because its state focused on appropriate regulations rather than rapid changes. Likewise Malaysia has benefited from the use of a PPP arrangement in delivering affordable houses. The secret behind its success is the provision of favourable housing policies (Abdullahi and Aziz 2011); Abdul-Aziz and Kassim 2011).

Its housing policy focused on making sure that its entire people, particularly the low income group, are assured access to housing. Regardless of its success a study conducted by Ismail and Azzahra Haris (2014) using questionnaire survey exposed top five challenges for adopting PPP comprise; "lengthy delays in negotiation", "lack of government guidelines and procedures on PPP", "higher charges to direct users", "lengthy delays because of political debate" and "confusion over government objectives and evaluation criteria". Ibem and Aduwo (2012) carried out a similar study in the Ogun state Nigeria, where the overview of the key challenges hindering the success of PPP in housing were listed as; an inadequate supply of developable land, insufficient housing finance and high building standards in the PPP scheme all of which result into deficient number of housing units and in affordability to low income earners.

From the above mentioned studies PPP incapacity and housing finance has appeared as a major setback in PPP housing projects in the developing countries. Also a study prepared for the United Nations Human Settlement Programme indicated five common challenges facing governments today in HPPP. "Financing challenges", "inadequate PPP capacity", "differing goals", "inability to integrate sustainability principles" and "lack of public acceptability" (Moskalyk 2011). But the above study clarified that these challenges depends on countries' levels of understanding and development towards partnership model. In the same study Moskalyk further noted that the rich countries have been successful in delivering affordable housing because of the high level of government subsidies, which lower housing costs. He added that these subsidies are a ‘luxury’ and cannot be afforded in the developing world. However it is possible to argue that these subsidies need not be a "luxury" but essential provided they are incorporated into a developing country's long term budget planning. If planned in advance and taken as a priority, such subsidies can be afforded. Hence it is necessary to have strategic plans and a favourable policy in order to successful deliver affordable housing.

On the other hand a study by Kwofie *et al*., (2016) revealed six critical success factors that influence PPP in Public Housing Project in Ghana. These included; involvement

of the government by providing guarantees, accurate project identification and technical feasibility, competitive and transparent procurement procedures, adequate legal framework, stable macro-economic condition and favourable economic policy and availability of strong and robust financial market. Similarly Kwofie's study highlighted that absence of clear guidelines and policies together with a lack of transparency in PPP agreements have been major challenges in Ghana.

Despite a number of previous studies that have researched on the challenges in adopting PPP in housing sector, no study has been published concerning the challenges for adopting HPPP in Tanzania. Similarly few similar studies have been done in other sectors such as water, health and municipal management (Chediel 2012; Mashindano *et al*., 2011; Ngowi 2006). Hence, this study aims to fill the gap in the literature by investigating the challenges or constraints hindering the success and adoption of HPPP in Tanzania.

RESEARCH METHOD AND DATA COLLECTION

A literature review has been used to provide experience in other countries and justification for the research topic. Nineteen HPPP challenges were adopted from reviewed literature and using questionnaire survey and semi structured interviews, the challenges that hamper the growth and success on HPPP approach in Tanzania were identified. The mixed method approach was preferred in order to offset the weakness of each tool considering the sample nature, time and accuracy of data (Kothari 2004). In that case the sample was purposely selected so as to obtain the targeted population with the relevant information needed. The target population for this study are stakeholders involved in PPP housing projects in Dar Es Salaam Tanzania. The rationale for choosing Dar Es Salaam as the study area includes: accessibility to conduct survey to obtain required data; also about 60 per cent of HPPP projects, PPP experts, construction professionals and head offices are located in Dar Es Salaam.

Therefore the target population includes public sector authorities (i.e. ministry, department, and housing agencies), private partners and the project consultants involved in HPPP projects in Dar Es Salaam. Unfortunately, there is no official list or standard database specifying the number of stakeholders' organisations involved in HPPP projects within the study area. In view of this, the target population involved in this study cannot be easily determined. Based on this the researcher identified the target population through Public agencies involved in HPPP projects and PPP experts. It is on this note that only two public organizations, including their list of projects (NHC183 projects and NSSF 1 project), 60% being based in the study area, private partners and consultants were identified. Henceforth the population size is small and the selected sample is typical of the whole and allowed intensive study (Kothari 2004). The interviewees were selected from the management staff of the public and private sectors while the questionnaire participants were company staff involved in similar projects. Statistical Package for Social Sciences (SPSS) was used to analyse data and calculate the scores.

The main findings of questionnaire and interview survey are summarised below:

A total of 38 questionnaires were administered to the targeted population. 28 questionnaires were returned which is equivalent to 78.6%. Similarly 13 interviews were undertaken. The response rate for both tools was considered very good in view of the total population. Out of 28 questionnaire respondents the following professions were involved; 5 quantity surveyors, 4 engineers, 3 architects, 1 lawyer, 3 land valuers

and 12 other professionals. While out of 13 interviewee, 3 were quantity surveyors, 5 engineers, 3 architects, 1 lawyer and 1 land valuer. According to the level of familiarity with PPP, 9, 12 and 20 out of 41 rated themselves as good, average and low respectively. Among them were 7 directors, 2 assistant directors, 3 project managers 3 heads of section and 18 other organization staff. The revealed demographic background of the respondents demonstrated that all key actors in PPP housing projects as well as varying management levels were all involved in the survey thus enhance the reliability and validity of the findings. Data collected were analysed using descriptive statistics. Mean score was used for the ranking of 19 identified challenges.

Findings show that PPP in housing in Dar Es Salaam is based on partnership between government agencies and commercial private property developers. However much attention has so far, been on the delivery of housing for high-income people, yet the challenges of inadequate housing units and housing affordability amongst low-income earners have not been addressed. The same situation was revealed in Ogun State, Nigeria (Ibem and Aduwo 2012). This shows that there is poor creativity in using the PPP method in developing countries in order to address the housing shortage for low-income group.

In response to the question about the status and performance of the PPP housing projects, it was given that during the survey period NHC had a total of 183 joint venture projects. 104 were completed, 35 were under construction with the majority being delayed for a couple of years and 29 projects have been terminated while 21 projects have stalled due to various reasons. This status clearly indicates the existence of challenges to its performance. Respondents were further asked to rate the performance and 70%, 21% and 9% of the respondents said that there is poor performance, average performance and very poor performance respectively. The Majority of interviewees commented that, since a bigger number of NHC joint venture projects were not so successful it did not set up motivation for more similar projects. For the NSSF HPPP project its status was stated to have good progress but it has faced delays which resulted from changes in design, shipping of the imported materials and adverse weather condition. Also it was reported that the private partner was facing financial difficulties.

In response to PPP awareness and its benefits, 60% of respondents' awareness is still little; benefits are marginal and very slow because of lack of enough skills and expertise. Subsequent to that, one of the interviewees, who was a quantity surveyor and a project manager commented that, “Even the said affordable houses are still not affordable to the low income, the reason given for the lack of affordability is that, the government is not willing to provide subsidies to such projects and no good policies have been put in place. Hence, for decades the preferred procurement method in building affordable houses to the low income group in Tanzania is through personal efforts in saving and building which can take 10 to 15 years or more to complete the construction and sometimes some of these houses remain incomplete, yet people still live in them despite their poor conditions”.

Response to the interview question posed to the PPP experts in relation to political willingness and stakeholders’ readiness towards PPP. All interviewees agreed that there is high political willingness towards the strategy because of successful stories from other developing countries like Malaysia and India, but due to inadequate enabling environment in Tanzania, PPP approach has not been successful as in other

countries. Some of the PPP experts in PPP units declared to have visited these countries for PPP training and were attached to PPP projects for hands-on experience. But it was revealed by two interviewees that the PPP unit has little or no impact towards the proposed PPP projects despite its existence. A number of new PPP projects have been initiated and some started for example "Dege Eco Village" without being submitted to PPP units for assessment and approval due to fear of government bureaucracy. This reveals that PPP Unit has been ineffective and underutilised; it is also possible that the PPP regulations are not enforced thus allowing a PPP project to take off without being evaluated and approved by the PPP Unit. Thus there is a need for the Government of Tanzania to re-examine its PPP Unit, policy and its guidelines.

On a questionnaire survey a list of 19 challenges for carrying HPPP project was designed based on previous studies (Abdullahi and Aziz 2011; Liu, Chan *et al*., 2014; Trangkanont and Charoenngam 2014a) respondents were required to 'rate their levels of agreement' on a '5 point Likert-scale where 1= strongly disagree, 2 = disagree, 3 = neutral, 4= agree and 5= strongly agree. The mean scores were quantified and each challenge was ranked accordingly as seen in table 1.

Table 1: Summary of responses on challenges in implementing PPP housing projects in Tanzania

Challenge	Mean score	Std. Deviation	Rank
Inadequate PPP skills and knowledge leading to poor planning and application	4.82	0.390	1
Poor PPP contract and tender documents	4.64	0.621	2
Inadequate project management and monitoring by public sector	4.57	0.573	3
Inadequate legal framework	4.54	0.693	4
Misinformation on financial capacity of private partners	4.50	0.509	5
Lack of competition	4.46	0.576	6
Delays	4.39	0.497	7
Corruption	4.29	0.600	8
Inadequate feasibility study	4.21	0.630	9
Differing goals between partners	4.18	0.819	10
Long term disputes and conflicts between parties	4.11	0.786	11
Inadequate government commitment and support	4.00	0.770	12
Insufficient capacity in procurement and negotiations	3.89	0.994	13
Poor risk allocation and management	3.79	0.957	14
In experienced private partner	3.68	0.819	15
Unequal qualifications and contributions of expertise	3.57	1.034	16
Poor enabling environment to attract competent partners	3.50	0.793	17
Inadequate mechanisms for recovery of private investors' capital	3.39	1.133	18
High costs in procuring PPP projects	3.36	1.193	19

The top 5 challenges have a mean score ranging from 4.82 to 4.50 including "inadequate PPP skills and knowledge", "poor contracting and tendering documents", "inadequate project management", "Inadequate legal framework" and "misinformation on financial capacity of private partners" A number of studies as described below had

similar challenges with few varying challenges. In this study lack of PPP skills and experience in PPP project scored the highest mean of 4.82 and was ranked first. This clearly indicates the cause for its slow progress and failures. This was also considered a big challenge in a study by Moskalyk (2011) and Zhang (2005). The 2nd and 4th ranked challenges, "poor contracting and tendering documents" and "Inadequate legal framework" agrees with a study by Abdul-Aziz and Kassim (2011), lack of strong and clear agreement was the most dominant failure factor In Malaysia. It was further reported during an interview that majority of the NHC HPPP contracts had major legal issues such as lack of an exit clause, contradictory provisions in an agreement, biasness in favour of their private partners, double standards and uncertain practice in the transfer of right of occupancy and non-adherence to the rules and regulations among partners. All this led to a number of projects being terminated, stalled and delayed. Also inadequate project management was a major issue raised during the interview because all the work of managing and project monitoring was left to the private partners in NHC HPPP thus giving them a loop hole to make alterations and in most cases the construction in site has been quite different from the agreed and authorized design hence leading into disputes which also appeared as the11th ranked challenge.

Misinformation on financial capacity of private partners appeared as the 5th ranked challenge in the questionnaire survey. Equally during the interviews it was mentioned that poor determination of the shareholding ratio and recovery period, and that lack of proper procedure on determining the financial status of the partners who are engaged in the JV agreement projects have been major challenges and have resulted into project termination. Similarly "lack of competition", "delay" and "corruption" have been ranked 6th, 7th and 8th respectively. On the other hand, competitive bidding should be stressed in order to eliminate corruption and allowing for transparency and best partner selection. While "inadequate feasibility study" and "differing goals between partners" had a mean score of 4.21 and 4.18 respectively and they were ranked as 9th and 10th position. "Differing goals between partners" was also cited by Moskalyk (2011) as among the five common challenges facing governments in HPPP project.

CONCLUSIONS

This study found that PPP did not perform well in housing projects in Dar Es Salaam City unlike other countries because of significant number of challenges experienced. The following were identified as the top 5 challenges; "inadequate PPP skills and knowledge", "poor contracting and tendering documents", "inadequate project management", "Inadequate legal framework" and "misinformation on financial capacity of private partners". These challenges have also been experienced in Thailand PLCH, unlike Malaysia, where a lack of robust and clear agreement emerged as the prominent challenge. While in Ghana, lack of transparency and absence of clear guidelines and policies had been their major challenges. Individual countries appear to have similarities as well as unique features and challenges in their PPP housing project. Their variances depend on countries' levels of understanding, priorities and development towards partnership model.

The identified challenges call for the need to address them thus providing a basis and drive for developing a HPPP framework model. Hence the study concludes that appropriate regulations and favourable housing policies among other factors are vital to the success of HPPP projects.

REFERENCES

Abdul-Aziz, A R (2012) Control mechanisms exercised in Malaysian housing public-private partnerships. *Construction Management and Economics*, **30**(1), 37-55.

Abdul-Aziz, A R and Kassim, P J (2011) Objectives, success and failure factors of housing public–private partnerships in Malaysia. *Habitat International*, **35**(1), 150-157.

Abdullahi, B C and Aziz, W N A W A (2011) The role of private sector participation in achieving anticipated outcomes for low-income group: A comparative analysis of housing sector between Malaysia and Nigeria. *African Journal of Business Management*, **5**(16), 6859-6890.

Chediel, Z (2012) Opportunities and challenges of using public and private partnership in delivery of water service, Published MSc Thesis, Mzumbe University.

Dixon, T, Pottinger, G and Jordan, A (2005) Lessons from the private finance initiative in the UK: Benefits, problems and critical success factors. *Journal of Property Investment & Finance*, **23**(5), 412-423.

Hodkinson, S (2011) The Private Finance Initiative in English council housing regeneration: a privatisation too far? *Housing Studies*, **26**(6), 911-932.

Ibem, E O and Aduwo, B (2012) Public-private partnerships (PPP) in housing provisions in Ogun state, Nigeria: opportunities and challenges. *In*: S Laryea, S A Agyepong, R Leiringer and W Hughes (Eds.), *Proceedings 4th West Africa Built Environment Research (WABER) Conference, 24-26 July 2012, Abuja, Nigeria*, 653-662.

Wenban-Smith, H (2014) *Population Growth, Internal Migration and Urbanization in Tanzania, 1967-2012 Phase 2 (Final Report)*. Working Paper, International Growth Centre.

Ismail, S and Azzahra Haris, F (2014) Constraints in implementing public private partnership (PPP) in Malaysia. *Built Environment Project and Asset Management*, **4**(3), 238-250.

Itika, J, Mashindano, O and Kessy F L (2011) *Successes And Constraints For Improving Public Private Partnership in Health Services Delivery in Tanzania*. The Economic and Social Research Foundation (ESRF), Paper No. 36

Jefferies, M, Gameson, R and Rowlinson, S (2002) Critical success factors of the BOOT procurement system: Reflections from the Stadium Australia case study. *Engineering Construction and Architectural Management*, **9**(4), 352-361.

Kavishe, N (2010). *The performance of Public Private Partnership in delivering houses in Tanzania (The case of the National Housing Corporation)*, Unpublished MSc Thesis, Department of Building Economics, Ardhi University.

Kidata, A J (2013) *A Brief of Urbanisation in Tanzania*. *In*: Prime Minister's Office Regional Administration and Local Government. Presented on 1 June 2013, 2013 Resilient Cities Conferences, Bonn.

Kothari, C R (2004) *Research methodology: Methods and techniques 2nd edition*. New Delhi: New Age International.

Kwofie, T E, Afram, S, Botchway, E, Kumaraswamy, M and Roumboutsos, A (2016) Critical success model for PPP public housing delivery in Ghana. *Built Environment Project and Asset Management*, **6**(1), pp.58-73.

Liu, T, Chan, A and Wang, S (2014) PPP Framework for Public Rental Housing Projects in China. *In*: Y Wang, H Ye, G Q P Shen and Y Bai (Eds.) *Proceedings of International Conference on Construction and Real Estate Management*, September 27-28, Kunming, China, 573-581.

Moskalyk, A (2011) *Public-private Partnerships in Housing and Urban Development*. UN-HABITAT.

Ngowi, H P (2006) Public-private partnerships (PPPS) in the management of municipalities in Tanzania: Issues and lessons of experience. *African Journal of Public Administration and Management*, **17**(2), 29-31.

National Housing Corporation (2006) *Joint Venture Policy*. National Housing Corporation, Tanzania.

National Housing Corporation (2010) *The National Housing Corporation Strategic Plan for 2010/11– 2014/15*. National Housing Corporation, Tanzania.

Sengupta, U (2006). Government intervention and public–private partnerships in housing delivery in Kolkata. *Habitat International*, **30**(3), 448-461.

Susilawati, C and Armitage, L (2004) Do public private partnerships facilitate affordable housing outcome in Queensland? *Australian Property Journal*, **38**(3), 184-287.

Trangkanont, S and Charoenngam, C (2014) Critical failure factors of public-private partnership low-cost housing program in Thailand. *Engineering, Construction and Architectural Management*, **21**(4), 421-443.

The United Republic of Tanzania (2009) *National Public Private Partnership (PPP) Policy*. Prime Minister's Office, Government Printer, Dar Es Salaam.

World Bank and Public Private Infrastructure Advisory Facility (2007) *Public-Private Partnership Units: Lessons for their Design and Use in Infrastructure*. Washington, D.C.: Public Private Infrastructure Advisory Facility (PPIAF) and the East Asia and Pacific Sustainable Development Department, World Bank.

Zhang, X (2005) Paving the way for public–private partnerships in infrastructure development. *Journal of Construction, Engineering and Management*, **131**(1), 71-80.

RESEARCH METHODS

THE EFFECTIVENESS OF MANAGING THROUGH TRUST THE MIDDLE MANAGEMENT LAYER OF A CONSTRUCTION COMPANY: PROPOSED ETHNOGRAPHIC RESEARCH

Antoin Cummins[1], Brian Graham[2], Ken Thomas[3] and Tadhg Lucey[4]

[1, 2&3] *School of Engineering, Waterford Institute of Technology (WIT), Cork Road, Waterford City, Ireland*

[4] *BAM Contractors, Kill, Co. Kildare, Ireland*

Managers are regularly identified as the key differentiating factors between competing organisations in the construction industry. The main occupant of the middle management layer of an Irish construction firm is the project manager. The continually important role project manager's play in the success of the construction company requires the maximisation of their potential. The importance of trust and its most appropriate form of adoption to the management in construction companies of maximising middle manager's potential is the subject of this paper. It particularly explores the suitability of ethnographic research in this undertaking. The researcher in this instance is employed as a project manager in a construction firm and the added nuances this introduces are reviewed, together with the literature relevant to both the topic of trust in the construction industry and ethnographic research.

Keywords: middle management, trust, ethnographic research

INTRODUCTION

In 1998 Sir John Egan introduced a key principle for the need to have respect for people, under the title of *Rethinking Construction*. The importance of this concept has increased as large construction companies have evolved into managers of the construction process, as opposed to, direct employing agents of the majority of construction industry participants in recent years. 'The competence of a construction company to effectively manage people has traditionally been viewed as deficient and remains a poorly understood industry, particularly in relation to its people management practices' Dainty and Loosemore (2012). A number of literature sources have identified the lack of studies carried out on management within the construction sector (Akhavan Tabassi and Hassan Abu Bakar, 2010) and the resultant need for further research within this area where '... the variables that are associated with leadership styles and which dictate the success of an organisation … are crucial areas for research in the construction industry' Naoum (Barassi). The aim of the research being undertaken is, from a construction project manager's perspective, to obtain the importance of the role which trust plays in most effectively managing the construction project manager and to confirm the belief that the project manager is a very crucial component in the success of an Irish construction company.

[1] antoin08@gmail.com

Cummins, A, Graham, B, Thomas, K and Lucey, T (2016) The Effectiveness of Managing Through Trust the Middle Management Layer of a Construction Company: Proposed Ethnographic Research. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 943-952.

RESEARCH CONTEXT

The full time employment position of the researcher conducting this research is considered a very important and unique perspective in the research undertaking. The researcher is in full time employment within BAM Contractors in Ireland, an operating company of the international Royal BAM Group, which is among the top three large construction companies within Ireland,(Foley, 2015, Bam, 2016). Bam Contractors are operating primarily within the Irish construction sector, which has experienced severe contraction, from €38.631 billion in 2006, to €9.12 billion in 2011. (CIF, 2013) reflecting the overall Irish economic recession. This has resulted in the 8no. companies classified as large (CSO, 2014) employing 4% of those employed within the industry, yet yielding a higher turnover per person than the 96% employed within the small to medium enterprises. The BAM Group potential with regard to a number of operating companies worldwide is considered a unique opportunity to establish a broader research findings validation process which can be applied to the Irish construction industry context. The potential resultant cross cultural comparisons have been identified (Tillmar, 2012) as allowing a combination of distance and familiarity which results in the discovery of dynamics which would not be apparent otherwise. This is an ideal opportunity for enhancing the volume and validation of the data collected with regard to the significance of trust in managing the construction project manager.

Construction project manager

A large construction company generates its turnover and residual profit through the completion of construction projects (vanWingerden, 2016). The literature reflects a chronological development of the recognition of the importance of the construction project manager as summarised below. The project managers, being the construction site manager occupies a positon within middle management of a construction company and are, 'becoming the key human resource for the modern contracting organisation' (Dainty *et al*., 2004), positioned at the heart of the success or the failure of the project for the contractor (Styhre and Josephson, 2006) They are experiencing an increase in responsibility, authority and decision making control (Parris *et al*., 2008). This results in the project manager being the one who plans and is responsible for maintaining day to day production and ultimately achieving all the construction project goals and targets (Syben, 2008). These projects are decentralised from the main office typically resulting in the development of a decentralised decision making structure (Gluch, 2009) and therefore they achieve this by pulling together the work of different teams and functional specialities (Dainty and Loosemore, 2012). The role therefore of the construction project manager is recognised as a very important and central resource for large construction companies (vanWingerden, 2016). The project manager's importance has been quantified and the research findings of Hyvari has shown that a project managers leadership ability accounts for approximately 76% of a projects success and 67% of a projects failure Zuppa *et al*., (2016). The project manager has an overwhelming influence on the success of a construction company.

The literature overwhelmingly identifies the very important role the project manager plays within a construction company, yet their correct management is a fine line which if incorrectly executed can have negative consequences.

A very significant factor in consideration of managing the construction project manager is that through an ever increasing scope of responsibility on the project manager, within a decentralised structure it can result in the project manager often

being a marginal figure, stressed and burnt out (Styhre and Josephson, 2006) within one of the most difficult industries within which to manage people and relationships (Dainty and Loosemore, 2012). This is further borne out through research studies which have shown that absence of top management support for a project is often a key factor in the failure of the project, (Naoum, 2011). In addition to the direct management of the main turnover source of the company, it is with the project managers that the main interaction at the organisations boundary occurs, placing the project manager in a 'gatekeeper' role also (Pemsel and Widén, 2011). This further increases the importance of the construction project manager's responsibility in contributing to the success of their construction company.

Managing the project manager

To ensure these project managers are carrying out their role and responsibilities competently without the negative consequences, they in turn require proficient management by top tier managers. The top tier management level within the large construction companies predominantly consists of members of the engineering profession. This in itself is a handicap, as engineers often pride themselves in not knowing anything about people and managing people (Druker, 1999). Placing such responsibility on these project managers' shoulders carries a significant degree of risk, on behalf of the construction company. By default, these project managers through the hierarchical structure, operate with a lot of trust placed in them by their managers and by reverse, the project manager places a degree of trust in their line manager.

Remarkable work outcomes from employees is always the goal (Akhavan Tabassi and Hassan Abu Bakar, 2010) and should also be the goal in managing the construction project manager. However, the understanding of the management of the middle management tier, remains one of the most marginalised fields of interest in research studies Styhre and Josephson (2006) which is mirrored within the construction industry (Akhavan Tabassi and Hassan Abu Bakar, 2010).

The deficit in research with regard to the management of the construction project manager is opposed to the importance of their role within the construction company and it is an aim of this research to contribute to this area of knowledge. The construction sector contextually is fraught with uncertainty. Differing projects offer differing unique problems and constantly changing parameters, which results in many small but complex decisions to be made daily (Dainty and Loosemore, 2012) and under uncertainty people need trust (Nooteboom, 2013). This is underlined by those research studies which were carried out in a construction industry context, Rowlinson *et al*., Thomas (1993) and Akhavan *et al*., (2010) through it was revealed that high 'relationship attitude' is a very relevant and appropriate leadership style. Immediately, therefore with the construction industry context applied, trust is a prerequisite to a successful relationship between project managers and their respective top tier managers.

Trust

The definition of trust has experienced a convergence over the past number of years, resting almost exclusively now with that of (Mayer *et al*., 1995) 'the willingness to be vulnerable to the actions of another party' and (Rousseau *et al*., 1998) 'trust is a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behaviour of another. Gillespie (2012) rightly points out that the three key dynamics to these definitions is that of

vulnerability, risk and interdependence. This interdependence, is therefore the two way relationship between the project manager and their manager.

The construction industry, is largely recognised and stereotyped as one of a highly fragmented industry (Ribeiro and Fernandes, 2010), in a distrusting environment (Cheung *et al*., 2011), with an orientation towards conflict and imperfect information (Lau and Rowlinson, 2009) and where risk management and standalone projects is the normal working environment for project managers to operate in. If actions could be undertaken without any risk, then trust would not be a requirement (Dahl Rendtorff and Jagd, 2010). This is not the case in construction and construction management research lags behind other fields of research in the affect trust building skills have on the success of construction projects (Zuppa *et al*., 2016). This research aims to bridge this gap in the specific application of trust in relation to managing a construction project manager. Trust has been identified and accepted as one of, 'if not the key sources of success in business relationships' (Bachmann and Zaheer, 2013), offering significant benefits to organisations (Searle, 2013) and being at the centre of building long-term relationships in project teams (P.M.Group, 2016). Trust encourages the sharing and positive acceptance of information (Dainty and Loosemore, 2012), with knowledge as a resource becoming increasingly recognised (Vanhala *et al*., 2011), with better working environments resulting from high trust relationships between supervisors and workers.

It is not organisations as a whole however, but rather, individual managers that trust others (Vlaar, 2013). This all indicates the suitability and criticality that the development and incorporation of trust into the relationship between construction project managers and their manager exists. Yet the perceived reality that trust is built up over a long period of time (Cooper, 2004) originating through phrases such as 'it takes twenty years to build trust but five minutes to ruin it' (Chow *et al*., 2012) does not lend itself to the cyclical, often transient nature of construction project teams. More recently, it has been established that the structural design of a construction company is highly influenced by the managerial view on the level of autonomy that every individual in their own department of work should have (Naoum, 2011). The construction industry, structurally designed around standalone projects, would indicate that there is a high level of autonomy afforded to project managers and in so doing, a considerable level of trust.

General management research consistently highlights that professional employees want autonomy and job freedom, not wanting to be controlled and directed (Naoum, 2011). Logically, one would assume that in large, complex organisations, top managers have a large demand on their time for external factors and high level tasks, resulting in facilitating an increase in delegation and less close involvement in details and supervision. This should increase the opportunity for project managers to achieve their aspirations for autonomy. The importance of top management attitudinal approach to how they manage the project manager gains greater significance in this context.

Trust, however is something that cannot be requested, only given (Cooper, 2004) and because of the characteristics of the construction industry, lack of trust is highlighted as one of the most critical issues (Phelps and Horman, 2010). It is important to recognise that the existence of trust is two way and that the project manager is extremely unlikely to perform exceptionally if they do not trust the top tier of management (Cooper, 2004). Dainty and Loosemore (2012) identify that the main

factor linked to positive commitment for all occupations is employee trust in management. Trust within an organisation has a multi-dimensional approach (Chen *et al*., 2011), therefore the importance of mutual trust between the project manager and their immediate manager is paramount for the organisation in achieving their goals.

Trust types

There are two very pertinent main streams of consideration which become relevant at this stage which this paper summarises and which the planned research will investigate further, with regard to trust and its importance to managing the construction project manager within the Irish construction sector. The first is the existence of a level of understanding beyond the employment contract between the project manager and their top tier manager introducing the concept of the psychological contract. The psychological contract represents the concept of trust or understanding that can exist, which is distinct from a physical piece of paper or contract (Banerjee *et al*., 2012). This psychological contract can set the dynamics of the relationship and the behaviour of those involved and is playing an important role in developing the understanding of contemporary employment relationships.

Beyond the relationship with their manager, the project manager will also invariably be influenced by the organisations culture (Lau and Rowlinson, 2009). Impersonal trust refers to the trust in impersonal company factors, such as top management, company's goals, structures, roles and vision or strategy (Vanhala *et al*., 2011). Organisational trust in the context of the traditional construction project team would be vertical trust between the project manager and the senior manager. However, this construct becomes less relevant when the decentralised nature of construction projects and the increased use of virtual technology such as email communication and collaborative databases for communication are becoming commonplace. The social interaction involved in nurturing the traditional vertical relationship trust is limited. This impersonal trust is nurtured and developed by the organisation rather than the individual manager. Perceived good treatment by the organisation can incite employee's obligation to reciprocate the organisation and thus provide the foundation for trust to develop.

Although the construction industry is one where working within teams is common place and personal relationships are inherently important, those who work within the industry are frequently disconnected from management (Dainty and Loosemore, 2012). In the context of the Irish construction industry, companies have an increasing management shortfall (Beesley, 2016), so the maximisation of the talents of those project managers already employed is of great importance. Due to the shortfall, there is a real possibility of opportunism and employee exit to another company. Where the possibility of defection and exit is real, trust becomes a significant factor as it has been identified as one of the most effective means to prevent defections (Chow *et al*., 2012) and an important tool in retaining and motivating employees (Donoghue and Wickham, 2008). This research will investigate and progressively narrow the trust literature to significantly focus on the project manager management, from both the organisation and top tier direct manager relevance. As it has been summarised, managing the project manager through trust, is a multi-dimensional concept, not solely restricted to the relationship between the project manager and their direct top tier manager.

RESEARCH METHODOLOGY

Good management of people has been identified as a mix of theory with practice and that the study of this subject area should reflect that experiential learning (Naoum, 2011). Various research methodologies, from experimental investigations to field studies have been undertaken and show the benefits of trust (Kramer, 2012). The perceived difficulty to derive measurable evidence required to support a hypothesis or theory within this industry (Bernold and Lee, 2010) requires a flexible methodology. Past research, has shown that participant observation is one of the most flexible research and data collection techniques (Williamson, 2006). It identifies that it has the flexibility to concentrate more on some techniques than on others in a non-linear fashion, the design of which is often developed during and as part of the process rather than being completely developed as the first phase (O'Reilly, 2012). This will allow for data from one technique to compliment or enhance data from another technique to create a 'rich description of the technical and social processes that occur within the project team' (Phelps and Horman, 2010).

Ethnographic research approach

As a result, the primary methodology proposed following the literature review for this particular study is an ethnographic research approach. The ethnographic research approach can be traced back through many years, with Aristotle setting out the need for observations as the basis for knowing (Bernold and Lee, 2010). This approach was introduced into construction research in the late 1960's, however since then has been rarely used within the construction industry context, although, it can reveal rich insights (Sarah Pink, 2010) nevertheless it has been utilised in the study of management in many top journals (Phelps and Horman, 2010). This will therefore afford the opportunity in learning of the adaptability of an ethnographic research approach in a construction industry application, with the added distinguishing layer of the researcher being a long term participant in the research category with both the beneficial nuances and potential impediments which this will introduce.

There are a number of considerations which the adoption of an ethnographic approach in this context introduces. Phelps and Horman (2010), identify demonstrating the validity and reliability of the data from a single site, such as a single construction project, being a major challenge. In this instance, this is interpreted as referring to a single Irish construction company. As a result, as outlined previously, the company within which the researcher is employed, is an operating company of a larger group of companies. This larger group and the other operating companies will be utilised to validate or otherwise the data obtained within the Irish construction company, and in so doing addressing this issue.

The second consideration is that of the researcher being an employee within the construction company which will form the axis of the ethnographic research. This introduces the difficulty, as identified by Phelps and Horman (2010), of maintaining consistency and rigour. Undertaking an ethnographic study, involves taking an 'apprenticeship' type role in the research setting and observing and participating to a changing level of involvement. However, in this instance, the ethnographer is also in the role of a project manager within the research setting, so it is recognised that this academic, emotional and professional interface will need to be monitored to ensure consistent, reliable and valid data is obtained. This constant mixture of academic life, personal life and fieldwork through everyday employment and job responsibilities however, has been identified in helping the avoidance of impulsive interpretations

which could be developed following academic findings on one side, or entirely on research findings on the other hand (O'Reilly, 2012). The perspective of a researcher employing ethnography, with a history of long term professional employment within the field of research in the private sector has been neglected in the ethnographic literature which is heavily weighted towards researchers from academia experiencing a period of familiarisation and estrangement (Atkinson *et al*., 2003) and their entry into the culture of the research field requiring an often lengthy trust building process.

The position of the researcher, while offering potential insights and personnel access, may also introduce significant obstacles, such as over familiarity, and 'over identifying with particular individuals, cliques or interest groups' where the insider who is deeply immersed may find it hard to 'gain analytic purchase on phenomena that are so thoroughly habituated as to prove immune to research orientated scrutiny' (Atkinson *et al*., 2003). The unique contextual standpoint at the outset of this proposed ethnographic research approach and the subsequent challenges to effectively overcome will contribute to the ethnographic research methodology literature. The participants selected and approached for data collection is a very important consideration (Naoum, 2007) as 'errors, miscalculations and poor judgement in human relations can be as devastating to the research effort as any notional or statistical error (Fetterman, 1989). The researcher in this instance is firmly an active participant rather than an uninvolved observer in a number of relationships within the research field. These relationships will involve participants suitable as candidates for data collection, such as interviews.

The concept of auto ethnography due to the deep immersion within the research field was considered. This approach is one which seeks to describe and analyse personal experience to understand cultural experience (Ellis *et al*., 2011). There are many viewpoints, both supporting and criticising the benefits of the incorporation of 'self' in the auto ethnographic methodology (Doloriert and Sambrook, 2012). This brings different ethical considerations, which in this context, primarily being, protecting the participants during the research and publication and the relational ethics of work colleagues talked about in the auto. While there will be a degree of these issues present within an ethnographic approach, the degree to which these issues would exist are considered less and coupled with intended to the company of employment, should be more acceptable. It has been identified that the majority of research on trust, to date has been conducted through surveys and some experiments (Goodall, 2012). It is not considered in this instance that experiments are appropriate or beneficial. A representative cross section of project managers and top tier managers will be selected and approached for participation. This will also be further underpinned by the selection and approach to a number of similar hierarchical managers within the broader BAM Group to add validity to the findings within the Irish construction sector employees.

CONCLUSION

The primary middle manager within the large construction company, is the project manager. This project manager is critically linked to the success of the construction company and the management of the project manager is therefore critical. Yet the construction industry is one within which relationships and people management has not been to the forefront. The industry is a fast paced, dynamic and often adversarial in nature, throughout every level of project deliverance. Typically the hierarchy of the

large construction company is populated by engineers, to whom the relational management of project managers does not come instinctively.

There is a degree of risk therefore in the project manager managing a construction project, which through default initiates trust in the project manager. Trust is therefore crucial, both to and from top tier manager, but also from the organisation itself. Through an ethnographic based methodology of research, the most relevant approach will be adopted, to garner as much tacit information relating to the appropriateness of trust as a primary component in successfully managing a project manager within a large Irish construction firm. Much of the literature on management within construction, contributes from a management and leadership theoretical standpoint, and then some construction sector associations are added. This research aims to reverse this, utilising the researcher unique position in researching the unique management project managers in the construction industry, and then the broader management theory applied.

REFERENCES

Akhavan Tabassi, A and Hassan Abu Bakar, A (2010) Towards assessing the leadership style and quality of transformational leadership. *Journal of Technology Management in China,* 5(3)**,** 245-258.

Atkinson, P, Coffey, A and Delamont, S (2003) *Key Themes in Qualitative Research.* United States of America: AltaMira Press.

Bachmann, R and Zaheer, A (2013) *Handbook of Advances in Trust Research.* Cheltenham, UK: Edward Elgar Publishing Limited.

BAM (2016) *About* BAM *Ireland.* Available at http://www.BAMcontractors.ie/about.htm [Accessed 7th April 2016].

Banerjee, R, Banerjee, S and Patwardhan, M (2012) Strength of psychological contract: A predictor of organisational effectiveness. *Journal of Organisation and Human Behaviour,* **1**(4)**,** 49-57.

Barassi, R (2011) *Wisdom*, Australia: Allen and Unwin.

Beesley, A (2016) *Building Sector Seeking Rapid Return of Emigrants*. The Irish Times. Available at http:// http://www.irishtimes.com/business/economy/building-sector-seeking-rapid-return-of-emigrants-1.2263338.

Bernold, B E and Lee, T S (2010) Experimental research in construction. *Journal of Construction Engineering and Management*, **136**(1), 26-35.

Chen, K-H, Yien, J-M and Huang, C J (2011) The perceived leader support behaviour for subordinate's creativity: The moderating effect of trust. *Journal of Social Sciences,* **7,** 257-264.

Cheung, S O, Wong, W K, Yiu, T W and Pang, H Y (2011) Developing a trust inventory for construction contracting. *International Journal of Project Management,* **29**(2)**,** 184-196.

Chow, P T, Cheng, S O and Chan, K Y (2012) Trust-Building in construction contracting: Mechanism and expectation. *International Journal of Project Management,* **30**(8)**,** 927-937.

Construction Industry Foundation (2013) Value of the Irish Construction Sector 2006-2011. Construction Industry Foundation.

Cooper, D (2004) *Improving People Performance in Construction*. Aldershot, England, Gower Publishing Limited.

Central Statistics Office (2014) *Business In Ireland 2012*. Dublin: Central Statistics Office

Dahl Rendtorff, J and Jagd, S (2010) Balancing trust and control in organizations: Towards a process perspective. *Society and Business Review,* **5**(3)**,** 259-269.

Dainty, A and Loosemore, M (2012) *Human Resource Management in Construction,* London: Routledge.

Dainty, A, Raiden, A and Neale, R (2004) Psychological contract: Expectations of construction project managers. *Engineering, Construction and Architectural Management,* **11**(1)**,** 33-44.

Doloriert, C and Sambrook, S (2012) Organisational autoethnography. *Journal of Organisational Ethnography,* **1**(1)**,** 83-95.

Donoghue, D W O and Wickham, D M (2008) Managing the psychological contract in competitive labour market conditions. *Journal of Global Business Issues,* **2**(2)**,** 23-31.

Druker, P F (1999) Managing Oneself. *Harvard Business Review,* 1999 (Reprinted January 2005).

Ellis, C, Adams, T and Bochner, A (2011) Autoethnography: An Overview. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research,* 12.

Fetterman, D M (1989) *Ethnography Step by Step,* Sage Publications.

Foley, B (2015) CIF top 50 revealed. *Construction: The Official CIF Magazine,* CIF.

Gillespie, N (2012) Measuring trust in organisational contexts: An overview or survey-based measures. *In*: R Bachmann, A Zaheer and L Curtis (Eds.) *Handbook of Advances in Trust Research 2nd Edition.* Cheltenham, UK: Edward Elgar Publishing Ltd.

Gluch, P 2009 Unfolding Roles and Identities of Professionals in Construction Projects *Construction Management and Economics***,** 959-968.

Goodall, C (2012) Working with Difficult to Reach Groups: A 'building blocks' approach to researching trust in communities. *In*: R Bachmann, A Zaheer and L Curtis (Eds.) *Handbook of Advances in Trust Research 2nd Edition.* Cheltenham, UK: Edward Elgar Publishing Ltd.

Kramer, R M (2012) Moving between laboratory and field: A multi-method approach for studying trust judgments. *In*: R Bachmann, A Zaheer and L Curtis (Eds.) *Handbook of Advances in Trust Research 2nd Edition.* Cheltenham, UK: Edward Elgar Publishing Ltd.

Lau, E and Rowlinson, S (2009) Interpersonal trust and inter-firm trust in construction projects. *Construction Management and Economics,* **27**(6)**,** 539-554.

Mayer, R C, Davis, J H and Schoorman, F D (1995) An integrative model of organisational trust. *Academy of Management Review,* **20**(3)**,** 709-734.

Naoum, D S G (2007) *Dissertation Research and Writing for Construction Students,* Oxford, UK, Elsevier Ltd.

Naoum, S (2011) *People and Organisational Management in Construction,* London, ICE Publishing.

Nooteboom, B (2013) Trust and innovation. *In*: R Bachmann, A Zaheer and L Curtis (Eds.) *Handbook of Advances in Trust Research 3rd Edition*. Cheltenham, UK: Edward Elgar Publishing Ltd.

O'Reilly, K (2012) Ethnographic returning, qualitative longitudinal research and the reflexive analysis of social practice. *The Sociological Review,* **60**(3)**,** 518-536.

P M Group (2016) *Managing Globally Distributed Teams*. ECI Workshop 24 September 2014 at CB&I in The Hague, NL. Available at http://www.pmgroup-global.com/news/Latest-News/construction-managing-globally-dispersed-team.aspx: PM Group [Accessed 7th April 2016].

Parris, M, Vickers, M and Wilkes, L (2008) Caught in the middle: Organisational impediments to middle managers' work life balance. *Employment Response Rights Journal***, 20**(2), 101-117.

Pemsel, S and Widén, K (2011) Bridging boundaries between organizations in construction. *Construction Management and Economics,* **29**(5)**,** 495-506.

Phelps, A F and Horman, M J (2010) Ethnographic theory-building research in construction. *Journal of Construction Engineering and Management,* 136(Special Issue)**,** 58-65.

Ribeiro, F L and Fernandes, M T (2010) Exploring agile methods in construction small and medium enterprises: A case study. *Journal of Enterprise Information,* **23**(2)**,** 161-180.

Rousseau, D M, Sitkin, S B, Burt, R S and Camerer, C (1998) Not so different after all. *Academy of Management Review,* **23**(3)**,** 393-404.

Pink, S, Dylan, T, Dainty, A and Gibb, A (2010) Ethnographic methodologies for construction research: Knowing, practice and interventions. *Building Research and Information,* **38**(6)**,** 647-659.

Searle, R H (2013) HRM and trust, or trust and HRM? An underdeveloped context for trust research. *In*: R Bachmann, A Zaheer and L Curtis (Eds.) *Handbook of Advances in Trust Research 3rd Edition.* Cheltenham, UK: Edward Elgar Publishing Limited.

Styhre, A and Josephson, P.-E (2006) Revisiting site managers work stuck in the middle. *Construction Management and Economics,* **24**(5)**,** 521-528.

Syben, G P (2008) A comparative consideration into paths of middle management in the construction industry. *European Journal of Vocational Training,* **45,** 184-211.

Thomas, J (1993) *Doing Critical Ethnography,* United States of America: Sage Publications.

Tillmar, M (2012) Cross-Cultural comparative case studies: A means of uncovering dimensions of trust. *In*: F Lyon, G Möllering and M N K Saunders (Ed.) *Handbook of Research Methods on Trust 2nd Edition,* Cheltenham, UK: Edward Elgar Publishing Ltd.

Vanhala, M, Puumalainen, K and Blomqvist, K (2011) Impersonal trust: The development of the construct and the scale. *Personnel Review,* **40**(4)**,** 485-513.

Vanwingerden, R (2016) CEO, Royal BAM Group NV - Project Management Seminar

Vlaar, P W L (2013) Trust and contracts: Together forever, never apart. *In*: R Bachmann, A Zaheer and L Curtis (Eds.) *Handbook of Advances in Trust Research 3rd Edition*. Cheltenham, UK: Edward Elgar Publishing Ltd.

Williamson, K (2006) Research in constructive frameworks using ethnographic techniques. *Library Trends,* **55**(1)**,** 83-101.

Zuppa, D, Olbina, S and Issa, R (2016) Perceptions of trust in the US construction industry. *Engineering, Construction and Architectural Management,* **23**(2)**,** 211-236.

AN INSIDER'S POINT OF VIEW - AUTO-ETHNOGRAPHY IN THE CONSTRUCTION INDUSTRY

Henning Grosse[1]

The Business School, University of Gloucestershire, The Park, Cheltenham, Gloucestershire, GL50 2RH, UK

This methodological work addresses the lack of auto-ethnographies in construction management and highlights how they might contribute to the field. Auto-ethnographers can readily conduct their research without facing entrance barriers since they study their personal environment. Drawing on a conflict with an architect, I explore my emotions and thoughts. I emphasise how reflexivity supported by background knowledge, perspective taking, and self-questioning helps me to explore underlying assumptions and reasons of my thoughts and feelings. Consequently, I argue for disruptive and uncomfortable reflexivity. Doing so, I can develop a more critical understanding of my own actions and emotions. Therefore, this work might help others to advance their reflexive skills. This confessional tale written from the researcher's/subject's point of view is never dispassionate; rather it provides passionate insights to one practitioner's view of managerial practice. It demonstrates how auto-ethnographies can offer deeply personal insight into a phenomenon than most other methods. Thus, auto-ethnographies will contrast outsider's perspectives and offer material for further reflection.

Keywords: auto-ethnography, practitioner-research, reflexivity, research methods, sociology

INTRODUCTION

In September last year, Martin Loosemore and I stood somewhere in the atrium at Lincoln University. We talked about my research, which is an auto-ethnography on my managerial practice. He said this could also be an interesting approach for some of his part-time students. Dealing with auto-ethnography for almost three years, I thought that it could be very beneficial for researchers on the one hand and practitioners on the other hand. I knew that I learned a lot about my research subject and myself. Later that year I received the ARCOM 2016 call for papers. I recalled our conversation and so the idea for this paper was born.

In construction management research ethnography has gained some momentum during the last couple of years (Pink, Tutt and Dainty 2013). However, for auto-ethnography things are different. Although Löwstedt's (2014) work contains significant auto-ethnographic elements, I am not aware of any explicitly auto-ethnographic research in our field. To this end, I seek to highlight what auto-ethnography offers to construction management research as well as to individual researchers. I will show how I used different approaches to foster and enhance my reflexive thinking. Hence, this paper should at best be regarded as a confessional part of my research (Van Maanen 2011).

[1] hgrosse@glos.ac.uk

Grosse, H (2016) An Insider's Point of View - Auto-Ethnography in the Construction Industry. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 953-962.

Introducing auto-ethnography

Ethnography is often described as the study of cultures (or parts of it) by participation and observation. Therefore, the ethnographer takes part in the daily activities of the group studied - he or she immerses into the field of study. In the field, the researcher usually takes just brief jottings, perhaps only single words, which the ethnographer later develops into longer field-notes. These descriptions form the basis for exploring the culture under study (Van Maanen 2011). To Pink et al. (2010, 658) "a good ethnographer immerses her- or himself in […] deep learning situations [...] where what is learned goes beyond what could be said in an interview and can only be known by being there, as events unfold."

Usually, ethnographers study cultures they are not a natural part of. Auto-ethnographers, however, explore their own culture. They 'conduct ethnographic research on their "people"' doing 'backyard ethnography' (Wolcott 1999, 170-1). The auto-ethnographer's interactions and subsequent thoughts, feelings and emotions are central in order to understand own experiences (Ellis 1999). An auto-ethnographer will "incorporate own personal narratives" in the research (Reed-Danahay 2001: 407). These studies may have different emphasizes - either to study the group the ethnographer belongs to or the personal experience of the researcher. Although some are rather critical about the latter - evocative - form of auto-ethnography (Anderson 2006), I think the personal view in which the researcher steps in the foreground offers a lot of insight - first of all, the individual understanding of events.

For ethnographers, getting access, immersing oneself into the culture, and participating in events can be a demanding task (e.g. Sage 2013). Not so for auto-ethnographers, getting access and participating does not pose a big obstacle, because the researcher is already there and accepted as part of the culture. It is the researcher's own environment. But this can create some headache for the researcher, especially when it comes to ethical questions regarding personal relations. I will come back on that later.

However, for some researchers - and I think about construction professionals - there is little opportunity to go somewhere else in order to do research. Especially part-time researchers are often unable to enter another setting because of time constraints of their first occupation. They often work full-time, going on leave in order to immerse (i.e. to work) somewhere else is not feasible - they have to make a living (Anderson 2006). These part-time researchers need time to read and write, so there is no time for yet another task. For them, ethnographies at home can provide a welcomed opportunity.

Auto-ethnographers do not need to get acquainted with the community, to learn the respective language and to acquire the special knowledge of this community; they are already familiar with the setting. This familiarity is what researching professionals can offer to the construction management community.

But, it is an insider's view and at times, it is difficult to maintain the ethnographic distance (Sage 2013). It is, as Ellis puts it (2004, 128), "[m]y own story - that's what I am involved in". The researcher must be willing to question her or his own practices as researcher and practitioner in a deep and often uncomfortable way (Pillow 2003). But this questioning needs the willingness to disclose oneself on the part of the researcher. The researcher needs to figure out whether he or she wants others to know about certain thoughts and feelings, whether disclosing might have detrimental consequences for the researcher or anybody else. However, practitioner-researchers offer a different although subjective perspective on practices in the construction industry.

The particular knowledge acquired by auto-ethnographers has further implication on the research questions addressed. There is little room for broad generalization, but auto-ethnographers can explore their own personal experiences deeper than most other approaches. This depth is what I am going for in my research.

MY RESEARCH PRACTICE

I am a part-time researcher in a PhD program and full-time construction professional. Using auto-ethnography, I investigate how negotiation practices and trust between the actors influence each other. To demonstrate what auto-ethnography can do, I use an event I wrote a field-note about for my research. But in this paper, I put the emphasis on auto-ethnography as a method, not on my research subject itself.

Since 1999, I have been running my own construction business of 38 employees most of them, bricklayers and carpenters. As a business owner, I negotiate on almost a daily basis. Hence, there is an intrinsic interest in the topic. I explore these negotiation experiences in order to learn about trust and negotiations.

Field-notes written about these negotiations are my ethnographic material. These field-notes not only contain a record of the negotiations but also what I thought and felt regarding these negotiations. Often, I use the voice recorder to take initial notes while driving after the event. Later, usually, in the evenings, I sit down and write longer descriptions of my experiences and subsequently reflect on them.

My experience shows that writing itself is not only a way of recording events; it serves as an analyzing technique as well (Emerson et al., 2011; Richardson & Adams St Pierre, 2005). The writing and subsequent reading forms a hermeneutic process of investigating my research field in more and more depth (Van Manen, 1990).

The following field-note deals with an experience I had with an architect I had done business with for some years.

> *One of the projects we had that winter was to make some changes to an old building. For my company, it was a rather small job, but nice to fill some gap between bigger projects. The house on a courtyard was very difficult to reach. Normally, our suppliers and we use lorries with a mounted crane to bring material on our building sites. But here almost everything had to be unloaded in the street and then carried over 20m by wheelbarrow. The necessary manpower was here the most significant cost driver. Since this was a small job and the building site was difficult to reach the prices per unit (e.g.; one cubic meter concrete) were reasonably high. However, we won the contract.*
>
> *In the course of the building process, it turned out, that some additional work was necessary. The architect and I went through the things to be done and the next day I made an offer and sent it via email. A couple of days later I got an email response from the architect on that offer.*
>
> *In the email which he copied to the client as well, he accused me of overcharging the client for the job. Reading this email, I got very upset; I immediately told my staff in the office about it. I was literally boiling inside. I could have exploded. I was very furious, close to throwing a temper tantrum. Then in this mood, I tried to call him. But I was lucky; I didn't reach the architect. Later when I calmed down a little bit, I wrote the email in which I explained my calculation in detail and called him again.*
>
> *When we talked on the phone, I told him about my anger and that I do not like to be accused in front of the client. I asked him, to discuss issues like that first between us in order to save face. I felt justified to confront him, but at some point during the call, it felt a bit as if I pushed too hard as if he were now in too much defence as if I was about to go too far. After the call, I immediately began to question whether I had argued too fiercely. Did I alienate him?*

My reaction to the email points to a couple of aspects of this event.

Emotionality

First, during the event, I felt strongly. To Ellis (2004, 19) "[w]riting notes was therapeutic. The process helped me organize my life, figure out what was going on, and then put away events and feelings in order to deal with what happened next." Dealing with strong emotions was the first thing to do in both of my roles - as a researcher and as a practitioner.

Although the therapeutic aspect seems somewhat overreaching, conflicts in the construction industry are often emotionally demanding if not traumatizing. In the case here, I understood that the accusation in front of the client made me very upset. Coming to know about my emotions helped me to deal with them. I developed some distance to my emotions. Writing about my feelings helped me to clarify that it is better to calm down. I cannot change my feelings and emotions immediately, but knowing what happens and beginning to understand, what triggers such feelings, makes it easier for me to cope with them. In this example, the embarrassment caused by him accusing me in front of my client was the critical point. He could have sent the email only to me; then it would not have caused these emotions in me.

Regarding my reaction on the mail, I know confronting business partners when in a bad mood or feeling strongly about something is often not a good idea. That is not entirely new, but this event and the writing about it reminded me of how important it is to act reflectively and to try to retreat and think (Van Manen 1995). At this point, writing was my way of retreating and reflecting.

Background knowledge

Second, I did not understand why he accused me of overcharging. He had not done so before, and I did not see how he came to conclude my prices were too high. On the contrary, we have had worked together for a couple of years and so I thought he should have known that my prices are reasonable. If he thought otherwise, there should have been no need to accuse me of overcharging in front of the client. I could not understand the situation I was confronted with (Adams 2012). The possible reasons for him acting this way were manifold; exploring some of them helped me to make sense of his action.

Usually, the house owner pays the architect as it happened in this case. Hence, he was supposed to defend the house owner's interests. This email could be understood less like a message to me as one to the house owner - saying to him 'Look, I am fighting for you.' Only to think in that way - although this was only one of many explanations - made it possible for me to adopt a stance of forgiveness. I could, then, be much calmer when talking to him.

Personal transformation

Third, I realized that my positivist education as a civil engineer is of limited use in a complex social environment. Through my training as a civil engineer, I learned to distinguish between right and wrong. I could assess whether the amount of steel reinforcement in a concrete beam is sufficient to sustain the load it has to bear or not. In other words, technical questions can be answered in a right-wrong-scheme. These objective criteria might still apply to social interactions with others, but they are only one (limited) dimension. We need to look beyond this technical dimension to find help to tackle questions regarding social interactions.

I cannot say whether the architect accused me of overpricing was right or wrong. He may have thought so; I did not. However, I am not in the position to judge who of us was right or wrong. These categories do not apply. It would have made a big difference if the architect had asked for an explanation of my pricing without blaming me in front of the client. But at the same time, he may have regarded my offer as so overpriced by his measures that it was an affront in itself. He may have felt right and justified doing what he had done. And I did as well when sending the offer and later when confronting him on the phone. At that point thinking in right-wrong-schemes does not provide much help. I learned about social complexity which does not fit with positivist understanding.

During the research process, my thinking gradually transformed. Starting from the right-wrong-scheme, I slowly but constantly came to understand (or believe) that there is no such thing as universal truth. We cannot know the other we are interacting with nor can we know ourselves. All knowledge is constructed and can, therefore, be deconstructed. It is only a tiny piece of our environment that we can know, and we know it just from a particular point of view (Berlin 2013).

Overestimated knowledge combined with a belief in right-wrong-schemes and strong emotions pose a specific danger. In the belief to know (about prices for construction work) and to be 'right' mixed with my strong feelings I talked to him, luckily not immediately after receiving the email but still aroused. In retrospect, I have to admit I could have easily ruined our relationship. I only accidentally avoided falling into this trap.

And therefore again, writing about it helped to illuminate the complexity of the phenomenon (Adams 2012). Writing is the tool I used to explore my experiences. However, the underlying pattern of being a practitioner and researcher is what provides the value for me. It is important to recognize that I wrote out of a research interest but inevitably wrote about an incident that had importance for my business life. Both worlds, that of the researcher and that of the practitioner, merged in my field-notes.

Ethics

Löwstedt (2014: 250) admitted that his "worker role occasionally grew out of proportion, to an extent that it inhibited the grand purpose of the study." In my case, it is my daily work, the job I make a living off, that sometimes overwhelms me and leaves no place for being a researcher. However, the constant back and forth between being practitioner and researcher was similar to Löwstedt (2014) my biggest resource. But I will not leave my research arena after a phase of immersion. I will stay there; this is my life and the job I want to keep.

By all its benefits, as auto-ethnographer, I have to be careful what I write because I want to interact in future with the persons I am writing about. Therefore, my guiding principle here is not to hurt anyone (Spicker 2011). Although "writing often feels isolating, the writer never acts in isolation" (Colyar 2013, 273). One constantly has to think about the consequences of publishing research - for others and oneself. I did continue and still work with this architect. Although he knows about my research and that I write about us, I still bear responsibility. So I went back to the field-note - I don't know how many times - trying to omit his identity, trying to obscure details, and writing it in a way that should not do harm to him. Actually, I asked myself, what would he say if he reads this.

But still I want others to know what happened and what I felt in a particular situation; however, I need to select thoughtfully what feelings I want them to know about. I cannot pick situations beforehand, since the very process of thinking through this situations, "figuring out what to do, how to live, and what [my] struggles mean", and composing text about it is the research process of auto-ethnography (Ellis and Bochner 2006: 111). Unless I investigate the meaning of an experience, I cannot make any decision about whether and how to write about it. Therefore, auto-ethnography when properly done is 'ethical practice' in itself (Ellis 2009, 317).

That also implies that unpublished field-notes can contain everything for the purpose of investigation. Hence, in my field-notes, I write and think about many things that bother me. What part of the field-notes become part of a publication and in what form they might appear is a completely different matter (Ellis 2009). I regard field-notes also as a form of journal writing. Writing field-notes, similarly to journals in order to publish them unedited, would take away from them a lot of their reflexive power because the anticipated audience would restrict the writing (Moon 2006). But the reflexive exploration of my experiences is the most important part of my research for me as researcher and practitioner. Therefore, some naïve playfulness has to be maintained in field-notes. Knowing that they do not go public unedited is the safeguard.

ADVANCING REFLEXIVITY: PERSPECTIVE-TAKING

In order to be more reflexive one has to adopt different perspectives (Pillow 2003). That may be the research's and practitioner's perspective, but also the perspective of the persons I interact with (which is a common coaching practice). This perspective-taking may sound somewhat abstract, but writing down in my private field-notes how the other person might have seen me in a particular situation is the first step. Hence, I tried to see myself with the other's eyes (Pillow 2003). I thought about the architect's mail again. When he wrote it, he might have regarded my offer as overpriced.

Accusations of overcharging are not unfamiliar in my business environment. Some seem to do business on the assumption that okay is what one can get away with. But apart from that claims about overcharging often arise because architects have different knowledge than we, construction managers, have. It is our daily business to calculate offers and to fix prices - it is our specialist knowledge. Architects lack some insight about that because it is only a small part of their job. Hence, he might have thought our prices were too high. If so, he felt right in being disappointed about my actions and had a justification for that email. If I were in his situation, I might have felt almost betrayed, and I would perhaps have reacted in the same way. So, how could I be angry with him? Rather, I had to question my own actions in the first place.

The architect estimates prices and subsequently budgets a project before kick-starting it. However, in order to realize these prices, he relies on the offers construction companies like mine make. When the prices are above the expectation, the architect finds himself in an uncomfortable situation. He had to explain to the client that the project exceeds estimated costs. In fact, he had to say that he was wrong. Architects (and everyone else too) find themselves trapped in multiple interdependencies - here the architect between the client and me. Perspective taking gave me an idea of how he might have experienced it.

Given the overrunning costs, he could also have acted in an anticipatory fashion. He might have assumed that the client regarded my offer as too expensive (or even the client told him so). Therefore, he might have felt an urge to confront me.

Some observed a "macho culture" on building sites (Löwstedt 2014, 253), and, given my experience, this is not the exception. I experienced the construction industry as a very competitive environment, where admitting failures or mistakes is usually regarded as weakness. When I explored the situation from the perspective of male dominance, the architect acted as the strong person, and I reacted by being outraged in a similar vein. Hence, the macho culture, the possible anticipation of the client's thoughts, and different knowledge about price building might have been ingredients of this conflict. If so, although I did not realize it back then, by calming down I somehow might have broken that vicious spiral of male competitiveness which was about to take off.

Here my background knowledge made it, at least, easier for me to take the architect's perspective. Throughout my years in business, I had talked to numerous architects about their struggles with clients and contractors and their respective sandwich position between them. Without this knowledge, I would have certainly struggled to see these explanations. They are the very mirrors needed in order to maintain a reflexive stance.

ADVANCING REFLEXIVITY: INTRIGUING QUESTIONS

Another way I foster reflexivity is to ask myself intriguing questions. For example:

> *Why did you react emotionally on this email? - Because he accused me of overpricing in front of the client. Charging unfairly high prices is not how I do business. How dare he to give the client this impression. - So is it the overpricing or the affront? - It's the affront. It's to be in the defence, having to fight this suspicion of overpricing. - Why that? - Because I worked hard to be regarded as a fair business partner. Now this impression of myself is destroyed or, at least, severely weakened. I feel I've to resurrect it and that is even harder to do as to build it from scratch. It's this uphill battle against suspicion. - So why all this effort? Why is this impression of being a fair partner so important to you? - Hmm, difficult question. Perhaps because I want to be treated fairly as well. - Do you really believe in this reciprocity? - Well, most the time. At least, I feel I act in a just way. - Ah, you're claiming moral high grounds …*

This inner dialogue could go on for almost eternity since critical reflection has no logical endpoint (Moon 2006). But I stop here because this amount of disclosure seems sufficient; ethical considerations are looming - I need to safeguard others, but also myself. Although this inner dialogue is a very brief example, it demonstrates the fast pace I came to underlying reasons and, therefore, uncomfortable questions (Pillow 2003). In this example, questions are asked from a rather distant, dispassionate position, in almost interrogatory manner, but the ways to frame such dialogues are manifold. By taking other's points of view or asking myself intriguing questions I am forced into reflection. To be reflexive is difficult to teach (Moon 2006) - but as demonstrated here, by constant exposure one learns how to become reflexive.

Critical reflection is to question underlying assumptions, to investigate their influence and to explore emerging new perspectives. Therefore, one cannot follow some set of questions or protocol. That would pose "pre-theoretical commitments" and any understanding would inevitably "conform to these discursive limits." (Jinks 1997, 522) The process of questioning must stay open. It rather requires a skeptical stance as to ask oneself: "How come you think so?" One needs to challenge constantly what may guide one's thought. It "is the necessity of an ongoing critique of all of our research attempts" (Pillow 2003, 192) what is needed.

Being reflexive, one inevitably uncovers uncomfortable realities (Pillow 2003). The architect just questioned the impression I wanted to give of myself - being a fair

partner. But he questioned this picture I wanted to give of myself. Then it is rather a matter of wounded vanity than of a substantial dispute about prices. The architect unintentionally just targeted a vulnerable spot in me. That may explain my emotional reaction to a great deal. It also helps to understand why I pushed so hard - tried to avoid similar situations in future. This touching of a vulnerable spot is the very uncovering of uncomfortable realities Pillow (2003) talks about.

These uncomfortable realities are located not only in my research practice but also my professional conduct. Hence, the challenge for the auto-ethnographer is to be critically reflective about not only the research process but the daily professional conduct of her- or himself as a practitioner. For me, that means to question what I do in business. I could have explained my prices upfront; I could have anticipated the architect's reaction. In every interaction, I have choices to make, and therefore, I take responsibility which route our interactions follow. To admit that I was wrong or, at least, could have taken another more appropriate choice is sometimes quite hard and uncomfortable. To find out that I am a bit vain about the impression I give is uncomfortable too. That is the challenging part. But rewarding is the feeling I get when I understand my own environment a little bit better; when I find new ways of dealing with conflicts when I create new choices for myself. Hence, "[r]eflexive ethnography is a uniquely challenging, yet rewarding, way of understanding" (Sage 2013, 104).

However, as I have shown above, apart from all learning and understanding, I also have to acknowledge my own limitations. I cannot possibly know all the reasons the architect had to write that email. I learned, what I perceive and understand is only a tiny piece of the social environment I am acting in (Berlin 2013). Hence, I should be careful not to jump too fast to conclusions (Weick 2006).

Therefore, I think that auto-ethnography is a very good fit for emphasizing the social character of our relationships on construction projects (Löwstedt 2014). Auto-ethnography points out the limited value of positivist thinking (Pink et al. 2010), helps the practitioner to understand the situations, their complexity, own reactions, and emotions better (Adams 2012) and to learning from experiences for better future actions (Brookfield 1995, Ellis 1999). But an auto-ethnographer can only tap these resources when reflexively exploring his or her environment.

Reflexivity requires others in order to mirror myself (Chiseri-Strater 1996). Only when taking different perspectives on the event, when trying to step into the shoes of the other, I begin to understand the complexity of the situation and how others could understand my actions (Pillow 2003). That is what auto-ethnography is about.

For a practitioner like me, being constantly forced to reflect on my own professional conduct is an invaluable source of learning. I can apply and, therefore, test the newly acquired knowledge right away and it makes different insights possible since learning takes place in one and the same person - me the practitioner-researcher. In inner dialogue, for example, the researcher is very much aware of the issues the practitioner feels not at ease with. Hence, the researcher can direct the questions very much to the crucial issues - the researcher can immediately go where it hurts most - in my example this is the impression I want to give of myself.

SUMMARY

For it is difficult to do this "back and forth between an insider's passionate perspective and an outsider's dispassionate one" (Van Maanen 2011, 77) I could not easily switch

off feelings and be dispassionate. Here, the overlapping of subject and tool becomes evident. A deeply involved, emotionally laden perspective, however, will offer a view an understanding, of an event different from a distanced, white collar view. This view is a biased, particular view of the event. Taking a postmodern stance, I do not think there is an unbiased, objective, neutral view of the event. Hence, I honestly offer mine and seek to explain how I came to understand the event in my very particular way.

It is the easy access to my own environment, the insider's knowledge, the depth I may reach, and personal involvement that can make auto-ethnographies worth reading. But auto-ethnographies have their limitations and risks. I may try as hard as I could yet I will never be an outsider to myself. There is the danger of being too inward looking or as Wolcott (1999, 175) noted, we do not see what is happening because the ethnographer does not "get out of the way." However inward or outward looking the account may be, it is a contrasting perspective to that of conventional ethnographies. I provide my personal insider's view of an event which provides a very different view compared to researchers using other methods. But my view might give another researcher's thinking a new spin.

REFERENCES

Adams, T E (2012) The joys of autoethnography: Possibilities for communication research. *Qualitative Communication Research*, **1**(2), 181-94.

Anderson, L (2006) Analytic autoethnography. *Journal of Contemporary Ethnography*, **35**(4), 373-95.

Berlin, I (2013) *The Hedgehog And The Fox: An Essay On Tolstoy's View Of History Second Edition*. Princeton and Oxford: Princeton University Press.

Brookfield, S D (1995) *Becoming A Critically Reflective Teacher First Edition*. San Francisco: Jossey-Bass.

Chiseri-Strater, E (1996) Turning in upon ourselves: Positionality, subjectivity, and reflexivity in case study and ethnographic research. *In*: P Mortensen and G E Kirsch (Eds.) *Ethics and Representation in Qualitative Studies of Literacy*. Urbana, LI: National Council of Teachers of English, 115-33.

Colyar, J E (2013) Reflections on writing and autoethnography. *In*: S L Holman Jones, T E Adams and C Ellis (Eds.) *Handbook of Autoethnography*. Walnut Creek, CA: Left Cost Press. 263-283.

Ellis, C S (1999) Heartful autoethnography. *Qualitative health research*, **9**(5), 669-83.

Ellis, C S (2004) *The Ethnographic I: A Methodological Novel About Autoethnography*. Ethnographic Alternatives Book Series. Walnut Creek, CA: AltaMira Press.

Ellis, C S (2009) *Revisions: Autoethnographic Reflections on Life and Work. Writing Lives Ethnographic Narratives*. Walnut Creek, CA: Left Coast Press.

Ellis, C S and Bochner, A P (2006) Analyzing analytic autoethnography: An autopsy. *Journal of Contemporary Ethnography*, **35**(4), 429-49.

Jinks, D P (1997) Essays in refusal: Pre-theoretical commitments in postmodern anthropology and critical race theory. *The Yale Law Journal*, **107**(2), 499-528.

Löwstedt, M (2014) 'Taking off my glasses in order to see': Exploring practice on a building site using self-reflexive ethnography. *In*: A Raiden and E Aboagye-Nimo (Eds.) *Proceedings 30th Annual ARCOM Conference*, 1-3 September 2014, Portsmouth, UK. Association of Researchers in Construction Management, 247-56.

Moon, J A (2006) *Learning Journals: A Handbook for Academics, Students and Professional Development Second Edition*. London: Routledge.

Pillow, W (2003) Confession, catharsis, or cure? Rethinking the uses of reflexivity as methodological power in qualitative research. *International Journal of Qualitative Studies in Education*, **16**(2), 175-96.

Pink, S, Tutt, D, Dainty, A and Gibb, A (2010) Ethnographic methodologies for construction research: Knowing, practice and interventions. *Building Research & Information*, **38**(6), 647-59.

Reed-Danahay, D (2001) Autobiography, intimacy, and ethnography. *In*: P Atkinson, A Coffey, S Delamont, J Lofland and L Lofland (Eds.) *Handbook of Ethnography*, 407-25. Thousand Oaks, CA: Sage Publications.

Sage, D J (2013) Building contracts: The trials, tribulations and translations of an ethnographic researcher in construction. *In*: S Pink, D Tutt and A Dainty (Eds.) *Ethnographic Research In The Construction Industry First Edition*. Abingdon: Routledge, 91-107.

Spicker, P (2011) Ethical covert research. *Sociology*, **45**(1), 118-133.

van Maanen, J (2011) *Tales Of The Field: On Writing Ethnography. Second Edition, Chicago Guides to Writing, Editing, and Publishing*, Chicago, IL: The University of Chicago Press.

van Manen, M (1995) On the epistemology of reflective practice. *Teachers and Teaching: Theory and Practice*, **1**(1), 33-50.

Weick, K E (2006) Faith, evidence, and action: Better guesses in an unknowable world. *Organization Studies*, **27**(11), 1723-1736.

Wolcott, H F (1999) *Ethnography: A Way of Seeing*. Walnut Creek, CA: AltaMira Press.

AGENT-BASED MODELLING AND THE BYZANTINE: UNDERSTANDING THE CONSTRUCTION OF ANTIQUITY'S LARGEST INFRASTRUCTURE PROJECT

J Riley Snyder[1], Lucy C Stephenson, Jan E Mackie and Simon D Smith

School of Engineering, University of Edinburgh, William Rankine Building, King's Buildings, Mayfield Road, Edinburgh, EH9 3JL, UK

Agent-Based Modelling (ABM) is an established method for simulating the actions, interactions and behaviours of autonomous agents. These agents can be individuals or collective organisations and the tool is able to assess the effects of these agents on the system as a whole. Based on theories of emergence and computational sociology, the ideas behind ABM were first developed many years ago but computational power of recent decades has allowed their utility to provide success in areas such as pollution, transmission of disease, culture, effective teams and cognition. Research is not yet widespread in the construction field, but successes have been seen in areas such as supply chain and network management. The aims of this paper are twofold. We ultimately intend to demonstrate the applicability of ABM in construction management and archaeological engineering; but initially we will outline its potential use via an overview of the Byzantine Water Supply system for the ancient city of Constantinople. Unlike similar counterparts in Classical Antiquity, the Eastern Roman Empire's 4th- and 5th-century water supply megaprojects, whose channels and bridges spanned hundreds of kilometres to bring fresh water to the burgeoning capital of Constantinople and its complex system of reservoirs and cisterns, is relatively under-explored. The paper demonstrates that ABM is able to provide greater and richer understanding of the use of resources in these ancient constructions.

Keywords: agent-based modelling, archaeological engineering, byzantine, heritage engineering, project management.

INTRODUCTION

The work of the modern construction manager, or construction management academic, concerns the ability and resourcefulness of society to provide for its needs via the built environment. We are concerned and interested in aspects such as value for money, project quality, care for the worker, sustainability etc. and investigate how these can be theoretically understood and continually improved. We forget, however, that these needs are not new and that the ability of the built environment to meet the demands of a civil society has been an area of significant interest for centuries, if not millennia.

We have two primary aims to cover in this paper: we shall briefly outline the nature of the infrastructure project built in the 4th and 5th centuries AD and the overall archaeological engineering research project that is currently investigating it; and we

[1] Riley.Snyder@ed.ac.uk

Snyder, J R, Stephenson, L C, Mackie, J E and Smith, S D (2016) Agent-Based Modelling And The Byzantine: Understanding the Construction of Antiquity's Largest Infrastructure Project. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 963-972.

will introduce and explore the use of Agent-Based Modelling (ABM) as a means to model a system for which there is a great deal of uncertainty and only partial understanding of the drivers that dictate its inputs.

CONTEXTS

The construction of Constantinople's water supply

It is the beginning of the decline of the Roman Empire in the third century A.D. and the emperor Diocletian has decided to split the empire into East and West. The small fishing village of Byzantium located on the Bosporus Strait was destined to become the successor of Rome. It was under the rule of Constantine that the city became the new capital of this reunified empire, which was to be renamed after its founder: Constantinople (Treadgold 2001). With this new status came a massive influx of population, and Constantine and his successors were determined that the city would have the prestige and luxury of a legendary metropolis which included that characteristic luxury of the Roman people: water.

Unlike Rome, however, there was not a plentiful source of natural water in the city. While, as Crow (2012) explains, there was already a short distance aqueduct from the Forest of Belgrade, believed to have been built during the reign of Hadrian, modern analysis (Crow et al., 2008) shows that the maximum hydraulic head of this source could not have provided running water for areas of the city higher than 35m above sea level. Thus, as the city expanded well beyond what the 'Hadrianic' line could provide, only 15 years after Constantine deemed the city as 'New Rome' and the new heart of the empire, his son, Constantius II commissioned a new water supply – showing their commitment to the development of Constantinople as a real long-term investment. Pointed out by the orator at the time, Themistius, a city can be impressive with public buildings and ornate decorations, but if it does not have water it will never thrive. He described Constantinople as being at threat of being a city "girdled by gold but dying of thirst" (Crow 2012).

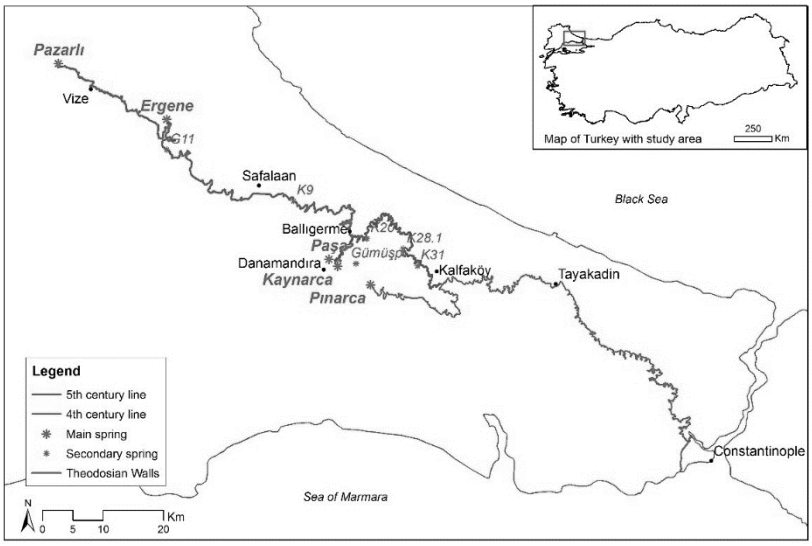


Figure 1: Map of the Byzantine water supply system, showing the 4th and 5th century lines (in blue and red respectively) and the spring sources feeding the system (Crapper et al, 2016)

The initial long distance line, approximately 246km in length (Ruggeri et al. 2016), was completed in approximately 373 AD, and is largely accredited to emperor Valens. Yet there was more to come – in the fifth century a further 181km line from Vize was added, with more monumental structures. The overall development of the water supply system is shown in Figure 1.

The system was not just vast but innovative, requiring sophisticated surveying to navigate the undulating landscape over several hundred kilometers and maintain

sufficient fall. While the aqueducts themselves are quite modest, mostly channels ranging from 0.65m to 2.20m in width, many bridges were were required to cross the many valleys of the terrain. Two such examples are shown in Figure 2.

Figure 2 Kumarlidere (L) and Kurşunlugerme (R) aqueduct bridges (Photos: Smith 2015)

Agent Based Modelling

Agent-based modelling (ABM) is a constructive research approach that enables the modeller to create a detailed hypothetical reality by generating virtual representatives ('agents') of the concepts that are relevant to the study, to assign qualitative or mathematical properties to these representative entities and to define logical rules that govern, constrain or produce their behaviour and interactions.

At its heart, ABM embraces the concept of emergence whereby the actions and behaviours of individual entities lead to patterns and regularities at a macro level that are not shown by the individuals. In the social sciences much research is given over to understanding not only how individuals behave but also how the interaction of these individual entities lead to macro-scale outcomes. ABM has thus become a popular tool in the social sciences, including economics, sociology and the interdisciplinary field of sustainability studies.

Like other types of modelling, ABM brings about simplifications of the perceived reality (Gilbert and Troitzsch 2005). Yet, it offers a different way of simplification by enabling the study of non-linear systems dynamically and as a whole, rather than in parts. It facilitates systematic reasoning and analysis in complicated or complex settings by generating virtual elements that are intended to imitate real-life processes. Agent-based models generate many independent and interacting virtual agents that are also the primary units of analysis. These agents are 'self-contained programs which can control their own actions based on their perceptions of their operating environment' (Huhns and Singh, 1997) and they can be built to represent independent and adaptive individuals or elements in a system.

While the social sciences have seen much of the early development of ABM, it is also increasingly being used for analysing social behaviour and organisation in an archaeological context. Important studies include Kohler et al.'s influential work on Anasazi populations (1996) and Graham's spatial and social network analysis based on Antonine itineraries (2006). ABM is also increasingly seen in more natural science and engineering applications, though specific construction applications are more limited. Notable examples consider the construction supply chain, such as the early work by Tah (2005) who used ABM to simulate alternative approaches to supply chain management. More recently, Son et al (2015) have reviewed the use of ABM in construction research and note, in particular, its ability to deal with emergent

behaviour in complex systems and the advantage that ABM might have over more reductionist approaches.

In the wider research studies, for which this paper forms a part, ABM will be mobilised to allow an understanding on three fronts: firstly, we aim to integrate information from different domains (archaeological, textual, historical and ethnographic) into a coherent narrative that can be visualised in simulation models. Secondly, simulation experiments will generate hypotheses about the day-to-day construction activities, different levels of agency and major organisational decisions taken in these levels. Finally, we intend to improve our understanding of the life of the individual as well as the socio-political and economic framework involved in large-scale construction projects in late antiquity through the reassessment of labour and material organisation set within a geographical and temporal framework.

This paper is an early exploration of ABM and will focus not on the construction of the aqueducts and bridges of the system, but instead on a resevoir built in what is now the south west of current Istanbul, the Fildamı cistern.

CASE EXAMPLE: MODELLING THE CONSTRUCTION OF THE FILDAMI CISTERN

The Resevoir

The Fildamı Sarnıcı (Turkish) or κινστέρνη τοῦ Ἕβδομου (Greek – Cistern of Hebdomon) was one of the largest known *open air* cisterns (or resevoirs) of Byzantine Constantinople (Figure 3).

The dimensions of the cistern vary very slightly between literature. We have used Ergil's (1974) interior measurements – 127 m by 76 m – and the survey completed by Bono et al in 2000 for the thickness of the walls (Figure 4). Ergil describes the cistern as being North-South orientated, and talks of how the land on which it sits slopes downwards to the east. This land orientation is also interesting because it is the motivation behind the monumental niches that are constructed into the outer face of the east wall – in order to strengthen the ability of the wall to resist the force applied by the water – and the inner face of the west wall – similarly to resist the force of the soil.

Figure 3 The Fildamı Cistern from South-West corner in 2014 (Photo: Crapper, 2014

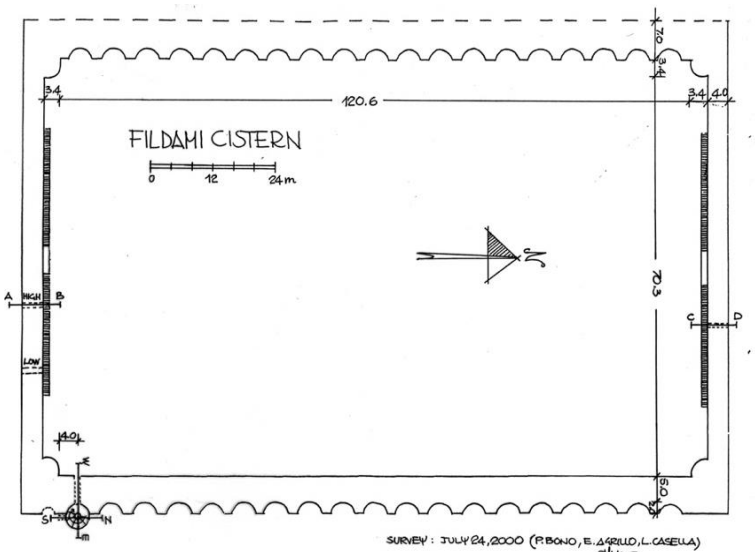


Figure 4 Plan of Fildamı Cistern (Bono et al., 2000)

The exact height of the cistern is slightly varied across several of the sources, since the remains of the structure no longer reaches the full height when first constructed. The survey carried out by Paolo Bono in 2000 suggests that at its highest point, the internal wall would have measured 11m. This suggestion is supported by Ergil, who stated that the interior walls were visible to a height of 10m, but that soundings taken at the time suggested that the cistern floor was 1m below what was then the ground level (Ergil 1974). Comparison with other contemporary structures such as the Anastasian Wall (see Snyder 2013) suggests that the foundations go down to a depth of 3.25m below current ground level.

Figure 5 'Opus vittatum' construction – alternating courses of stone and brick. (Photo: Smith 2014)

Primarily, the walls of the cistern are constructed in *Opus vittatum*, a typical Roman form of construction in this example consisting of alternating layers of bricks and of cut stone facings with a rubble core. Focussing on the internal walls which expose more of the facing - there are eight stone and rubble layers, and nine brick. A typical layer of bricks consists of five courses of square bricks, approximately 33 cm long and 3-4 cm thick – with the layers of mortar between the brick horizontally and vertically being the same thickness of the bricks themselves (Ergil 1974). The bricks were all made specifically for the purpose, and contain no brickstamps to betray when they were made.

Modelling scenarios

As a historical artefact, modelling the structures of Constantinople's water supply presents interesting challenges: that they were built cannot be disputed, their presence and mass are clear tributes to the engineering and construction skills of the time. Yet how they were built is more difficult to know. This of course is a primary aim of the overall research; but most modelling exercises will be undertaken with some degree of how a specific system works and this is, unfortunately, absent for the water supply of

Constantinople. A number of scenarios of possible representations of the construction plan and sequence, based on analogous archaeological and historical data, were considered in order to allow modelling to commence. These ranged from a strategy of stockpiling, whereby all materials arrived to the site before construction commenced, to the completion of a single course of stone or brick masonry over 40m of length before continuing to the next course. Each scenario represented a plausible stratigy for construction based on our limited knowledge of historical building practices of the Late-Antique and Byzantine east. The scenario modelled for this paper was chosen to be that construction occurred in 4m-length sections of wall, built to full height.

The advantage of this scenario is fourfold: First, it represents evidence of work gang practices found in the archaeological record such as in the 'contract sections' seen at the Eifel Aqueduct in Cologne (Hodge 1992). Second, unlike the course-by-course scenario, all the types of materials used in its construction can be considered (if not the whole quantities) in each run of the model. Third, this allows for the rapid upward construction evidenced by thick mortar joints and creep from increased load on masonry whose mortar has not fully cured. This is typical of Late Antique and Byzantine structures, most commonly discussed in regards to Constantinople's Hagia Sophia (Mark and Çakmak 1992, 1994), which was finished in just under five years. Fourth, from a purely pragmatic standpoint, this scenario significantly reduces computational runtime compared to the others, making it possible to test a wider range of inputs.

The development of the working model

Using the scenario outlined above, the model was constructed using the ABM modelling platform *NetLogo*, an open source, GPL programming environment developed by Uri Wilensky at Northwestern University in 1999 (NetLogo, 1999) which uses at its core the concept of *Turtles* and *Patches*. A *Turtle* is an autonomous agent that can move – for instance a Stone Mason (worker) or Limestone (material); while a *Patch* is one that is a stationary geographic location, such as a quarry or brickyard. Alongside the agents are the inputs to the model, such as number of quarries, distance to travel, size and quantity of brick-kilns etc. The levels of these inputs have to be hypothesised – unlike the modelling of modern construction where time and motion studies might be undertaken, no such data exists. Therefore historical and archeaology texts are used, principally that of DeLaine's *The Baths of Caracalla* (1997) to provide estimates for manpower and ox-cart productivity.

The agents are set up using the input parameters and are then subject to procedures that dictate their function and govern how they interact with other agents. Utilising these core principles, a model logic is constructed to recreate the production and transportation of the materials to the Fildamı worksite.

It is important to note that in this early form of the model the actual construction of the wall itself is not modelled, only the delivery of the materials. It is reasonably assumed that a separate model could be created to represent the actual construction but this is not yet done. Instead we need to ensure that the materials are delivered in a timeous manner to allow the construction to proceed.

Figure 6 shows an annotated, typical arrangement of the turtles and patches for the developed model.

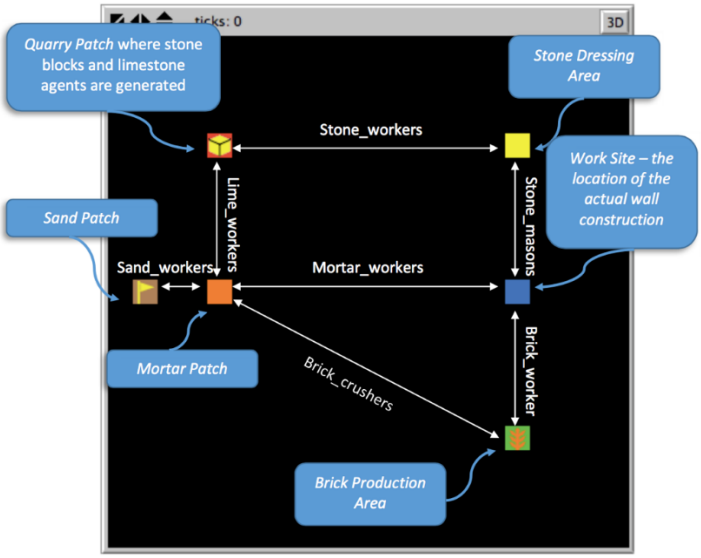


Figure 6 Schematic of Agent Based Model of Fildamı Cistern Wall Materials Production and Delivery

RESULTS

The outputs from the model of the system can be manipulated, tested and experiemented with in a manner consistent with normal modelling methodologies. Key outcomes from this model include:

- The most obvious outcome and easiest to appreciate is the overall time to complete this modelled system, that is the production and delivery of the materials necessary to construct the 4m width, full height (approx 13.5m) of the Fildamı wall is approximately 36,500 minutes – just over 50 days. But clearly this is dependent on the nature and level of the inputs to the model.
- These inputs will affect the outcomes or 'response' of the model and a working, valid model can be subject to a sensitivity analysis to determine which are the most prominent. This was done via Factorial Experimentation with the conclusion that the brick kilns had greatest effect among all inputs, that is the response to the model, in this case time to complete, was most sensitive to the number of brick kilns used.
- With no historical or archaeological data pertaining to the construction of Fildamı other than the structure itself— i.e. size and type of workforce, completion time, material acquisition, planning— this model has allowed us to input analogous information from other historical construction projects. Intitial results have so far confirmed that under similar conditions, Fildamı could have been built of local raw materials in a timely manner with no need for large-scale stalkpiling (with the exception of brick) or significant idle time for labourers.
- Previous research in the archaeological community has been limited in its ability to fully justify certain parallels that have been drawn between both historical and modern phenomenon. This model has provided a means of testing scenarios built upon common late-antique building processes attested to in the wider archaeological and historical records as well as test plausability of conclusions drawn in other studies in the field of engineering archaeology.

DISCUSSION: APPLICATION OF ABM TO ARCHAEOLOGICAL ENGINEERING AND MODERN CONSTRUCTION MANAGEMENT

The case example above is an early overly simple implementation of Agent Based Modelling to attempt to hypothesise the construction of an ancient structure. Nevertheless, the usefulness of ABM has been demonstrated. Results can be generated even when there is very little direct data to represent the input to the system and, as mentioned above, this is crucial when studying construction in late antiquity, where evidence is sparce and seeing the whole picture is seemingly impossible. The model is manipulated to propose multiple 'what-if' scenarios on how the materials production and delivery could be undertaken, with straightforward inspection used to make a judgement on the likelhood and efficiency of the resulting output. As Siebers et al (2010) acknowledge, this contrasts with alternative modelling platforms such as Discrete-Event Simulation, which, while having been thoroughly tested with simple modern cyclic processes (see for example the early work of Smith, 1998) require robust mathematical representations of the input parameters.

From an archaeological perspective, this model has been extremely fruitful as a confirmation exercise for the use of comparitive data to study past construction projects. Using pre-industrial labour rates (manpower) has been commonplace in the field of archaeological engineering since DeLaine's (1997) seminal work on the Baths of Caracalla in Rome. These figures play a central role in our model, acting as the parameters for the rate at which a process can be completed. The common assumption has been that the labour rates would be similar for any craftsman before mechanisation, as long as the tools and general social conditions were the same. While the results of this model do not secure these rates as fact for late antiquity, they have proven to be reliable constraints in all scenarios.

The real beauty of ABM is its scalability and adaptability and this is realised on a number of levels. First is that a model, once constructed, can in itself be then used as an agent in a larger model. For instance, in the case study example above the model for the construction of a single section of wall can then be inserted as an agent in to another model of the construction of the whole cistern; this in turn could be an agent in a model of the whole infrastructure system. The second feature of ABM to be noted is that the rules and procedures that are written in to the code to dictate how the agents behave and interact can be easily updated, again in a way that the 'hard-wired' logic of say Discrete-Event simulation cannot. In our early application, these rules are very simple such as 'move one ox-cart load of limestone from the Quarry Patch to the Mortar Patch'. This does not have a stochastic aspect nor does it include human social behaviour. However, it could be investigated how social interactions influence the system output where each agent is given a decision-theoretic model of the world, varying beliefs about its environment and individual motivations on how to respond to the actions of others. This is a future aim of our research, where we can build upon extensive work already well established in the psychology field (see for instance Marsella et al 2004).

Finally, ABM can be coupled with Geographic Information Systems (GIS) to provide updatable and/or scenario based data input on the geographic nature of a system. Archaeologists have been using GIS within ABM for some time but mainly as a means of investigating settlement and movement patterns. In the case of constructing the water supply of Constantinople, where the system to be modelled is approximately

470km in length (Ruggeri et al. 2016), this is an exciting possibility to explore innovative avenues of GIS and ABM applications. Early work coupling QGIS with NetLogo is already underway on the water supply with an adapted model presented in this paper as a part.

CONCLUSIONS

- Via a short modelling example ABM has been shown to be effective in dealing with the complex interactions of seemingly autonomous agents, allowing for the emergent properties of these systems in a way that existing simulation methodologies might not manage.
- This can be assumed to be the case not only for the historical example shown in this paper but also for modern construction applications: ABM has potential to grow from its mostly sociology and economic applications to being a fruitful research approach for many construction applications.
- The outcomes of the model of the Fildamı resevoir demonstrate that of all the agents and inputs to this system it is the 'Brick Kiln' that is the most significant. The importance of this finding to the archaeology community is very significant. While there is good understanding of the process of historic brick production, the involvement of bricks in the actual construction process as a whole is rarely properly explored in modern research, let alone viewed as a critical player in scheduling. The results here suggest that brick production and brick use are potentially more significant in the overall management and undertaking of Byzantine construction than previously thought.

ACKNOWLEDGEMENTS

The authors would like to acknowledge funding from The Leverhulme Trust, grant number RPG-2013-410, which has enabled the research behind this paper to be undertaken.

REFERENCES

Bono, P, Agrillo, E and Casella, A, (2000) *Fildami Cistern Survey*. 24 July 2000.

Crapper, M, Ruggeri, F, Ward, K A and Crow, J (2016) A Steady Flow Hydraulic Model of the 4th and 5th Century Aqueducts Supplying Constantinople. *In: 4th IWA International Symposium on Water and Wastewater Technologies in Ancient Civilizations*, September 17-19, 2016 Coimbra, Portugal.

Crow, J (2012) Ruling the waters: Managing the water supply of Constantinople, AD 330–1204. *Water History*, **4**(1), 35–55.

Crow, J, Bardill, J and Bayliss, R (2008) *The Water Supply of Byzantine Constantinople*, London: The Society for the Promotion of Roman Studies.

DeLaine, J (1997) The baths of Caracalla: a study in the design, construction, and economics of large-scale building projects in imperial Rome. *Journal of Roman Archaeology*, Portsmouth, R.I.

Ergil, T (1974) A Byzantine Cistern near Istanbul. *Archaeology*, **27**(1), 42–47.

Gilbert, N and Troitzsch, K G (2005) *Simulation for the Social Scientist*. Buckingham: Open University Press.

Graham, S (2006) Networks, agent-based models and the Antonine itineraries: Implications for Roman archaeology. *Journal of Mediterranean Archaeology* **19**(1), 45–64.

Hodge, A T (1992) *Roman Aqueducts and Water Supply*. London: Duckworth Publishers.

Huhns, M N and Singh, M P (1997) *Readings in Agents*. California: Morgan Kaufmann Publishers Incorpated.

Jerkø, S (2009) Construction versus archaeological sectors: Enemies or friends? *In*: *Proceedings of the 5th Nordic Conference on Construction Economics and Organisation*, Reykjavík, Iceland, 10-12 June 2009, Vol. 1, 121-131.

Kohler, T A, van West, C, Carr, E P and Langton, C G (1996) Agent-based modeling of prehistoric settlement systems in the Northern American southwest. *In*: *Proceedings of the Third International Conference/Workshop on Integrating GIS and Environmental Modeling*. Santa Fe: 21–25.

Mark, R and Çakmak, A S (1992) The Hagia Sophia: From the Age of Justinian to the Present. New York: Cambridge University Press.

Mark, R and Cakmak, A S (1994) Mechanical Tests of Material from the Hagia Sophia Dome. *Dumbarton Oaks Papers*, **48**, 277-278.

Marsella, S C, Pynadath, DV and Read, S J (2004) PsychSim: Agent-based modeling of social interactions and influence. *In*: *Proceedings of the International Conference on Cognitive Modeling* Vol. 36, pp. 243-248).

NetLogo (1999) *A Multi-Agent Programmable Modeling Environment*. https://ccl.northwestern.edu/netlogo (Accessed 24 March 2016).

Ruggeri F, Crapper M, Snyder, J R and Crow J (2016) A GIS-based assessment of the Byzantine water supply system of Constantinople. *In*: *4th IWA International Symposium on Water and Wastewater Technologies in Ancient Civilizations*, Coimbra, Portugal. September 17-19, 2016 Coimbra, Portugal.

Siebers, P O, Macal, C M, Garnett, J, Buxton, D and Pidd, M (2010) Discrete-event simulation is dead, long live agent-based simulation! *Journal of Simulation*, **4**(3), 204-210.

Smith, S D (1998) Stochastic analysis of cyclic construction processes. *In*: W Hughes (Ed.) *14th Annual ARCOM Conference, 9-11 September 1998, University of Reading*. Association of Researchers in Construction Management, Vol. 1, 127-36.

Snyder, J R (2013) *Construction requirements of the Water Supply of Constantinople and Anastasian Wall*. The University of Edinburgh, Edinburgh, UK.

Son, J, Rojas, E M and Shin, S W (2015) Application of agent-based modeling and simulation to understanding complex management problems in CEM research. *Journal of Civil Engineering and Management*, **21**(8), 998-1013.

Tah, J H (2005) Towards an agent-based construction supply network modelling and simulation platform. *Automation in Construction*, **14**(3), 353-359.

Treadgold, W (2001). *A Concise History of Byzantium*. Basingstoke: Palgrave.

SOCIAL VALUE

THE DEVELOPMENT OF AN ACTIVITY ZONE CONCEPTUAL FRAMEWORK TO IMPROVE SOCIAL VALUE IMPLEMENTATION IN CONSTRUCTION PROJECTS USING HUMAN ACTIVITY SYSTEMS

Fady Farag[1], Peter McDermott and Carrie-Ann Huelin

School of the Built Environment, The University of Salford, The Crescent, Salford, M5 4WT, UK

Current research shows the sporadic success of recent policy and legislative documents which encourage public clients to utilise their expenditure strategically to produce social outcomes in addition to traditional outcomes. Analysing social value outcomes revealed a lack of methodologies or approaches that enabled procurers to deliver social outcomes consistently. Social delivery was excluded from core business objectives and approached as a philanthropic activity. A lack of understanding and inconsistency in the social delivery journey in public projects has led this research to consider the New Product Development concept which underpinned the Generic Design and Construction Process Protocol development. Using the GDCPP can enhance social value delivery by transforming it into a construction project task, similar to that of design and production management, with its activities being task driven and undertaken by cross-functional teams across all phases. An analytical review of the GDCPP advantages and disadvantages revealed that the soft nature of social value was not aligned with the hard system thinking behind the GDCPP. To overcome this issue, a soft system methodology was introduced to overcome this challenge through using Human Activity System models. This study attempts to deliver a conceptual framework/a new activity zone to organise social value delivery processes across all phases of construction projects.

Keywords: social value delivery, human activity system modelling, soft systems methodology, process modelling-new public procurement

INTRODUCTION

Historically, public procurement has drawn the attention of governments, policy makers and public organisations because of its socio-economic impact on the performances of national economies (Thai, 2001). Public procurement is used to reduce the gap between what is offered to solve increasingly complex social problems and the limited resources available to solve them (Mulgan, 2013). McCrudden (2004) stated that in the USA and Europe governments use public procurement to remedy social issues such as ethnic inclusion and youth utilisation. Recently, the UK government has published policy and legislative documents such as the National Infrastructure Plan (2013) and the Public Services (Social Value) Act (2012) to encourage local and central governments and authorities to delivery social objectives for their local communities as a by-product of procuring their infrastructure projects.

[1] f.f.farag@edu.salford.ac.uk

Farag, F, McDermott, P and Huelin, C-A (2016) The Development of an Activity Zone Conceptual Framework to Improve Social Value Implementation in Construction Projects Using Human Activity Systems. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 975-984.

Despite encouraging social value delivery through these policy and legislative documents, the implementation techniques mentioned in these documents (which guide procurers in delivering societal benefits) are limited, fragmented and inconsistent. The process limitation which can deliver social value outcomes has confused public procurers and left them without consistent or standardised approaches when attempting to identify what benefits can be delivered (Public Services Social Value Act, Year on Report, 2014).

This research focuses on the Generic Design and Construction Process Protocol, driven from the process theory, which can be utilised to overcome the construction industry's problems, such as an unstructured learning process, unpredictable results and stakeholders' lack of coordination and communication. These construction problems were found to be similar to the social value delivery problems and thus create an opportunity to utilise such an approach to improve social value delivery processes. The GDCPP was developed in 1998 as a response to the Egan and Latham reports which transferred manufacturing processes to procurement, construction and design activities (Cooper *et al*., 2005). Although the social value processes can benefit from the GDCPP a number of challenges that can hinder its usage. Therefore, the GDCPP's process thinking combined with Soft System Methodology and its modelling concept, the Human Activity System, is used to overcome the challenges. This paper aims to develop a conceptual framework which provides an enacted social delivery value process independent of individuals' roles.

CONFUSION AND CONFLICT IN SOCIAL OUTCOMES

Despite the inclusion of corporate social responsibility in organisations' strategic management, it has failed to solve the growing flux of social issues because profit maximisation has been their main goal (Porter and Kramer, 2011). Increased complexity in social issues and diminishing governmental resources has triggered a change in how business success is viewed. Societies have changed their business success expectations and now believe that public money should be utilised in a more socially responsible manner (Mulgan, 2013). However, as the range of social issues has grown, conflict and confusion has grown among stakeholders due to their different perspectives on how to approach the topic. Proter and Kramer (2011) argued that private companies tend to have a short term perspective on social value, do not fulfil their clients' requirements and ignore elements that have an influence on the long term impacts of their business. Governments, on the other hand, may have worsened the approach by looking to solve their social problems at the expense of businesses.

In addition, as multiple definitions of social value have emerged, they have relied on the background, understanding and judgement of stakeholders. With each definition a high number of social issues emerge creating potential deliverables. There is also confusion regarding choosing what can be delivered and how the delivery process can be started (Westall, 2012). Social sustainability describes social value from a development outcome perspective (Magis and Shinn, 2009) and social procurement describes it from a procurement perspective (Barraket and Weissman, 2009). Social value (SV) itself has emerged as a term describing the maximisation of additional outcomes which exceed the initial delivered product in order to fulfil the social needs chosen by clients (Public Services Social Value Act, 2012). Accordingly, social value's nature is subjective, diverse and qualitative as it varies across industries, sectors and projects and from one stakeholder perspective to the other (Russel, 2013). In some cases, social value has been viewed as a philanthropic activity which is

analysed independently from market values and which is detached from core business strategies (Porter and Krammer, 2011).

Evidence on the lack of guidance for social value implementation processes

The Public Services Social Value Act (2012) did not contain any information on processes or procedures to assist procurement officers in delivering SV (LePage, 2014). Porter and Kramer (2011) and MacLaren (2011) indicated that frameworks and reliable methodologies which can guide the delivery of social value are still incomplete and, in many business cases, missing. Bratt *et al*., (2013) concluded that a gap between social value at a strategic level and at a project level exists due to the lack of sound implementation processes which can defend business decisions against public scrutiny. The HM Treasury (2014) *Social Value Act One Year On* report indicated that public procurers were impeded by the uncertainty surrounding SV delivery under current policies which is viewed as fragmented and inconsistent.

Confusion arises as to how public procurers align SV objectives without conflicting with the EU and national rules and regulations (Chevin, 2014). Because public procurers have to comply with procurement rules and achieve commercial competitiveness, they are discouraged from an innovative interpretation of SV policies (Thai, 2001). LePage (2014) argued that scrutinising procurement activities in order to reduce corruption within public contracts forces procurers to become risk averse which reduces the level of organisational support for innovative methods of implementation, creating a need for process standardisation.

The impact of lacking guidance on social value delivery processes

The results of delivering SV outcomes without sound implementation processes has been significant in public construction projects where success has been inconsistent and sporadic (Brat *et al*., 2013). As the numbers of social issues (which construction projects could attempt to solve) increases procurers are left with the cumbersome task of choosing what and how to deliver without guidance, making these projects lost opportunities (LePage, 2014). Also, public procurers sometimes tend to justify their SV decisions retrospectively because of their soft non-quantifiable nature which conflicts with the prevailing procurement culture of quantifying outcomes such as cost and time. This retrospective justification neglects SV's most important impact which is its long term influence (Russel, 2013).

Because of its qualitative nature, measuring SV's impact varies significantly based on different stakeholders' perspectives and priorities. These diverse perspectives limit the ability to precisely capture social outcomes and thus quantifying SV is hardly achieved (MacLaren, 2011). LePage (2014) explained that, despite the public sector having competent procurement practitioners, these practitioners are unable to assess SV outcomes due to a lack of benchmarking data or sound measurement processes. Russel (2013) explained that because of SV's non-quantitative nature, the assessment process has to contain a certain degree of subjectivity or a qualitative nature which requires a level of flexibility for assessment processes.

The Generic Design and Construction Process Protocol (GDCPP)

Traditionally, construction projects have focused on final products and have neglected delivery processes which, in turn, has reduced consistency and diminished learning experiences which require an improvement to the delivery processes rather than to the final products (Kagioglou *et al*., 1999). As response, Cooper *et al*., (2005) have sought to develop a new process protocol based on the New Product Development

(NPD) concept, a manufacturing industry concept, so that the whole product's development (from the first steps of capturing a clients' needs to the delivery and replacement of a product) can be considered as 'one' consistent process.

The Generic Design and Construction Process Protocol (GDCPP) has emerged to improve delivery processes and final outcomes through process modelling in order to enhance workflows and activities' perception. The process modelling enables construction teams to manage and co-ordinate these activities in order to achieve final outcomes (Carmichael *et al*., 2004). Usually project management has focused on the construction phase only and has neglected other phases. In contrast, the GDCPP reviews the whole project life cycle in order to improve business cases, reduce conflicts and eliminate confusion between stakeholders (Kagioglou *et al*., 1998). The GDCPP projects' delivery processes consist of overlapping stages and gates where certain activities are performed and data collected in each stage in order to ensure that goals are achieved before moving to the next one (Kagioglou *et al*., 1999). The gates have flexible mechanisms where a 'start' mechanism is conditional upon the delivery of a specific activity in a specific time. The project may proceed when it is not vital to 'stop' it when the information or activity needed is not vital (Cooper *et al*., 2005). Finally, providing feedback from the different phases allows the projects' performance to be measured and introduces subjectivity to the process (Cooper *et al*., 2005).

Activity zones (sub-processes)

Activity zones are the sub-processes of the GDCPP consisting of a structured set of activities and processes performed by cross-functional teams aiming to fulfil common project objectives which are task-driven (and not function-driven) such as creating appropriate design solutions. Because tasks are cross-functional, participants of the 'zones' are determined based on the specific project task and/or process and are referred to in terms of their primary responsibilities. An activity zone could simply be carried out by a single person or could consist of complex networks of people and stretch between relevant functions and/or organisations depending on the size and complexity of the project. As shown in figure 2, activity zones span across four main stages covering the pre-project, pre-construction, construction and post construction phases and are further broken down into ten sub-stages providing more detail.

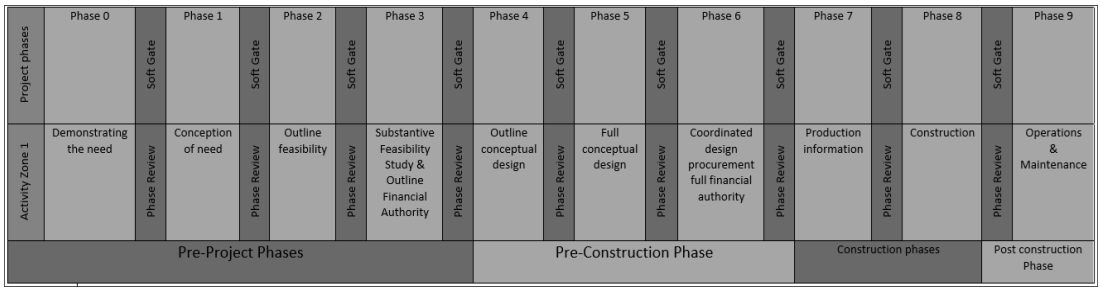


Figure 2: Activity Zone Structure (Source: Cooper et al., 1999).

The activity zones for the Process Protocol were defined as the following:

- Development management
- Project management
- Resources' management
- Design management
- Production management

- Facilities' management
- Health and safety, statutory and legal management
- Process management
- Change management

The process management activity zone is significant for the construction sector as it plays a role independent of all the other activity zones. Kagioglou *et al*., (1998) make the distinction between a conventional view of a project manager and the Process Management role where the latter, as the title suggests, is concerned with the enactment of the process, rather than the project. Key to the success of each phase in the process is producing project deliverables (the reports and documentation associated with each phase). In this respect, the Process Management role is to facilitate and co-ordinate the participants required to produce these deliverables.

Soft Systems Methodology (SSM)

Farag and McDermott (2015) concluded that Soft Systems' Methodology (SSM) is a suitable inquiry methodology designed to investigate difficult to define problematical situations; this aligns well with SV's soft nature and unclear definition. SSM uses systems' concepts as the method of enquiring about problematical situations rather than directly producing solutions. SSM is based on the assumption that knowledge is socially constructed and depends on the different perceptions of individuals formulating logical explanations in order to improve common understandings for a certain group of individuals concerning their problematical situation and how should they approach it (Wilson, 2001).

Using Human Activity Systems' models to produce a SV activity zone

Human Activity System modelling (HAS) is the SSM's tool which models the tacit knowledge of the problem situation held by participants in order to produce solutions by comparing these models with real situations. HAS produces informative models by exploring facts and reasoning of the situation from the participants' perspectives (Checkland and Scholes, 1999). Wilson (2001) argued that HAS models use stakeholders' perspectives to find solutions to problems through producing activities which can be performed by stakeholders in order to solve the problem. HAS models are chosen from a wide spectrum of systems. At one end there are the 'primary task systems' models which represent permanent organisational structures and their objectives (Checkland, 1999). At the other end are the 'issue based systems' models which represent the softer issues raised by the stakeholders which are hardly ever located on an organisational map and have temporary relevance.

Developing HAS models

Every HAS model has a root purpose equivalent to business objectives which represents a transformation process. This purpose is called the Root Definition (RD). A RD has multiple elements one of which is the world view (W) upon which any transformation process depends, based on participants' perspectives of the world. Elements which define the people, processes and the environment that contribute to the problem situation are added to make the model richer and to produce a diverse range of activities. Smyth and Checkland (1976, cited in Checkland and Scholes, 1999) indicated that the CATWOE elements improve the overall quality of the models. These elements are: Customers who are the victims or beneficiaries of the transformation (T) process; Actors who implement the transformation (T); the Transformation process which overarches the transformation of inputs into outputs;

world view (W) which makes the transformation (T) meaningful from the perspective of the participants; Owners who can stop the transformation process, and Environmental constraints which are the surroundings of the systems which can affect them but which cannot be controlled by the systems. (Wilson, 2001). Figure 3 shows how HAS models consist of subsystems representing the different elements of the CATWOE, with each subsystem consisting of activities which are performed to achieve the overall objective of the system with the activities logically contingent on others (Checkland and Scholes, 1999).

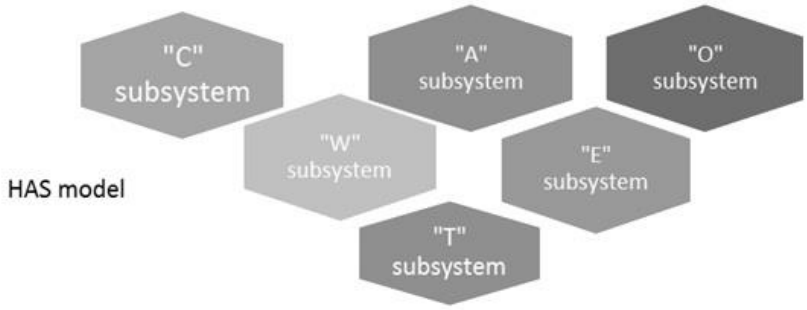


Figure 3: HAS Model and CATWOE Subsystem (Source: Checkland, 1999)

ANALYTICAL DISCUSSION

Advantages and possibilities of the GDCPP

The GDCPP's main advantage is the cross functional processes of the 'activity zones' which can deliver any objectives that have been agreed on by the project team. With the activity zones being linked to a myriad of disciplines, as mentioned earlier, and with them being task orientated they can include and deliver these objectives as part of the core business case of a project. This can be aligned to what Porter and Kramer (2011) argued is needed in the successful achievement of social value; it needs to be a core business deliverable (Design, development, facilities and resource management in GDCPP) and not merely be a philanthropic process. Hence, a SV activity zone would be treated in a similar manner to any of the traditional disciplines of a construction project.

The gap between strategic objectives and operational level activities in SV delivery can be reduced by cross functional teams because the process responsibilities are transferred from senior management to operational level cross-functional individuals who can provide their inputs into the tasks. Through their inputs, the cross functional teams can reduce confusion and ambiguity (which is generally found in SV delivery) by providing a diverse range of information to support the decision making process (Cooper, 1994). Any confusion about SV activities' details can be solved through the processes' logical dependency.

Kagioglou *et al*., (1999) explained that processes can be broken down from strategic to operational levels through modelling because the processes are multi-levelled and high level processes logically depend on lower level ones. Modelling activity zones produce the multiple level processes responsible for task delivery by identifying 'what' the high/strategic level processes are and breaking them to lower/operational level processes in order to answer 'how' they are achieved. Social value delivery processes can be consistent through what Cooper (1994) indicated as the 'start/stop'

(progressive fixity) approach, because although the processes are reviewed at the end of each phase the approach does not automatically require the project to stop which provides flexibility and allows simultaneous activities to be carried out (which is one of the benefits of the NPD concept).

Disadvantages of the GDCPP and using SSM

The soft and subjective nature of SV was not taken into account when developing the initial concepts of the GDCPP and its activity zones. The NPD concept, as a source of the GDCPP, was developed based on hard systems' thinking which delivers engineering solutions (Cooper, 1994). In hard system thinking the end goal of the system is given at the start of the phase and the problems are well defined which makes the system's main purpose be to find the most suitable solution for a well-defined problem through systematic rationality. However, hard systems with their different stages are insufficient to deal with unclear problem situations, with a flow of messy incidents (Checkland, 1999). Therefore, the GDCPP maintains the characteristics of a hard system with the cross-functional tasks (such as project, design and resource management) being defined at the beginning of the project. This means that, in its traditional form, the GDCPP would not be able to deal with social value delivery and its activities.

Therefore, an approach which can accommodate the soft, subjective nature of social value and which can develop a new activity zone should be used. This approach will be the HAS models, developed through SSM, which have the ability to model activities that can be used to provide a solution to soft issue problems. HAS models' adoption would benefit from the application of the GDCPP because it models the tacit knowledge of project participants and converts that knowledge into activities which can possibly be implemented after discussion between participants (Checkland, 1999). This approach is also aligned with a stance of Kagioglou *et al*., (1999) who wrote of interviewing cross functional team members in order to answer the 'what' and the 'how' questions regarding the activities. Accordingly, the usage of the GDCPP and the HAS models would strike a balance between the standardisation needed to create and improve the delivery process and the subjectivity needed to deal with the soft nature of the social issues.

Towards an activity zone conceptual model

In this activity zone conceptual model, information (gained via interviews) will be generated from key stakeholders (clients, Tier 1 and2 contractors) concerning a diverse range of SV outcomes, deliverables and methods of delivery. Similar to what Hindle (2007) argued the information from interview responses is analysed to generate HAS models through textual analysis where CATWOE elements are identified from texts creating initial RDs and its CATWOE subsystems. Each subsystem consists of a group of activities generated by a 'verbs in the imperative' modelling language. As shown in figure 4, these activities are then mapped against the GDCPP phases from phase zero to phase nine. Activities which suit the pre-project phases are assigned based on the clients' understanding and the rest of the activities similarly follow the same logic to be mapped across the full duration of the project. Activities may be divided and used on more than one phase.

Other activities may be used on one phase only depending on how stakeholders view them. Gates between the phases will be activated whereby activities will need information and actions before proceeding to the next level following the concept of

stage gates discussed earlier. This allows clients to understand where they need to intervene between phases zero and nine of the project and gives them a 'holistic' view of the project's timeline so that social value interventions can be planned in inventive ways within the phases.

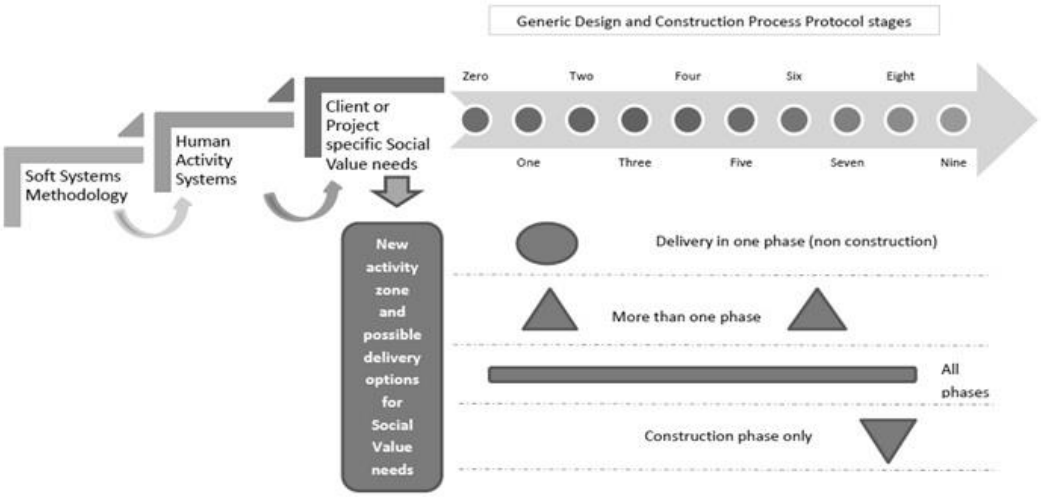


Figure 4: Social Value Activity Zone Conceptual Framework

CONCLUSIONS

Despite social outcomes being promoted through multiple legislative and policy documents nationally, the success of public projects in delivering such outcomes has been inconsistent. Little attention has been given to guiding public procurers in delivering social value outcomes as public documents do not provide consistent delivery methods (because social value was considered more as philanthropy rather than as a core business objective). This study builds on the GDCPP to investigate how to improve social value processes in the construction sector through an activity zone which can standardise these processes. Analysing the advantages and disadvantages of the GDCPP has provided an argument for developing a social value activity zone.

This activity zone will have SV as its project business objectives and will create a task oriented rather than end products' oriented approach in order to improve the overall quality of delivery processes. The activity zone (framework) focuses on the tasks and processes which guide and support work towards social value, independent of the people, relevant functions and/or organisations that perform those tasks and processes. Given the challenges which have appeared by analysing GDCPP usage in SV delivery, the HAS model, from the SSM, was chosen to deal with the soft, subjective nature of SV as the GDCPP was not designed to deal with anything but hard systems.

Given the complexity of the construction sector, the variety of projects' conditions, and the different issues that formulate a challenge for this conceptual framework, the model might need further refinement. It is expected that the present study will contribute to social value management by adding a new activity zone that can enhance a project's social performance. The priority in future research will be to empirically test the model and assess its performance in different settings and conditions.

REFERENCES

Barraket, J and Weissman, J (2009) *Social Procurement and Its Implications for Social Enterprise: A literature review, Working Paper No CPNS 48*, The Australian Centre for Philanthropy and Non-profit Studies, Queensland University of Technology: Brisbane.

Bratt, C, Hallstedt, S, Robèrt, K H, Broman, G and Oldmark, J (2013) Assessment of criteria development for public procurement from a strategic sustainability perspective. *Journal of Cleaner Production*, **52**(1), 309-316.

Carmichael, S, Tzortzopoulos, P, Cooper, R and Chan, P (2004) Beyond process protocol: A review of the generic design and construction process protocol to explore future work. *In*: *Proceedings of the first International SCRI Symposium (Salford Centre for Research and Innovation), University of Salford, Salford, UK*, 30 - 31 March.

Checkland, P and Scholes, J (1999) *Soft Systems Methodology in Action: Includes a 30 Year Retrospective*. Chichester, West Sussex: John Wiley and Sons.

Checkland, P (1999) *Systems Thinking, System Practice: Includes 30 Years Retrospective*. Chichester, West Sussex: John Wiley and Sons.

Chevin, D (2014) *No More Lost Generations Creating Construction Jobs for Young People*. House of Commons: London, UK.

Cooper, R, Aouad, G, Lee, A, Wu, S, Fleming, A and Kagioglou, M (2005) Process management in design and construction. Oxford: Blackwell Publishing Ltd.

Cooper, R G (1994) Perspective: Third Generation New Product Processes. *Journal of Product Innovation Management*, **11**(1), 3-14.

Erridge, A and Hennigan, S (2012) Sustainable procurement in health and social care in Northern Ireland. *Public Money and Management*, **32**(5), 363-370. DOI: 10.1080/09540962.2012.703422

Official Journal of the European Union (2014) *Directive 2014/24/EC of The European Parliament* and of The Council of 26 February on Public Procurement and Repealing Directive 2004/18/EC.

Farag, F and McDermott, P (2015) Using soft system methodology to approach social value outcomes in public procurement. *In*: C Egbu (Ed) *Proceedings of Going North for Sustainability: Leveraging Knowledge and Innovation for Sustainable Construction and Development, 23-25 November 2015, London South Bank University, UK*. CIB International Conference Proceedings, 50-59.

Hindle, G (2007) Developing a systemic textual analysis methodology based on the human activity system modelling language of soft systems methodology (SSM). *Systems Research and Behavioral Science*, **24**(6), 599-612.

HM Treasury (2013) *National Infrastructure Plan*. London: Crown Publishing.

HM Treasury (2014) *The Public Services (Social Value) Act 2012: One Year On*. London: London: Crown Publishing.

Kagioglou, M, Cooper, R, Aouad, G, Hinks, J, Sexton, M and Sheath, D (1998) *A Generic Guide to the Design and Construction Process Protocol*. Salford, UK: University of Salford, ISBN: 0-902896-17-2.

Kagioglou, M, Cooper, R, Aouad, G and Hinks, J (1999) The process protocol: Improving the front end of the design and construction process for the UK industry. *Journal of Construction Research*, **5**(1), 361-71.

LePage, D (2014) *Exploring social procurement*. Vancouver, BC, Canada: Accelerating Social Impact CCC Ltd.

Maclaren, V (2011) *Briefing 1: Introduction to Social Value*. NAVCA's Local Commissioning and Procurement Unit.

McCrudden, C (2004) Using public procurement to achieve social outcomes. *Natural Resources Forum*, **28**(4), 257-267.

Mulgan, G (2013) *The Locust and the Bee: Predators and Creators in Capitalism's Future*. Oxfordshire: Princeton University Press.

Porter, M E and Kramer, M R (2011) Creating shared value. *Harvard Business Review*, 62-77.

Russel, S (2013) *Journey to Impact: A Practitioner Perspective on Measuring Social Impact*. Midland Heart.

Magis, K and Shinn, G (2009) Emergent principles of social sustainability. *In*: J Dillard, V Dujon, and M C King (Eds.) *Understanding the Social Dimension of Sustainability*. Oxon: Routledge, 15-44.

Thai, K V (2001) Public procurement re-examined. *Journal of Public Procurement*, **1**(1), 9-50.

UK Parliament (2012) *Public Services (Social Value) Act 2012*. London: The Parliamentary Book Shop.

Westall, A (2012) *Briefing 2: Measuring Social Value, Social Outcomes and Impact*. NAVCA's Local Commissioning and Procurement Unit.

Wilson, B (2001) *Soft System Methodology Conceptual Model Building and Its Contribution*. London: John Wiley & Sons Ltd.

THE ROADSIDE WORK-SEEKER PHENOMENON IN THE SOUTH AFRICAN INFORMAL CONSTRUCTION SECTOR

Sylvia Hammond[1], Paul Bowen[2] and Keith Cattell[3]

[1] *PO Box 22475, Fish Hoek, 7974, South Africa*

[2&3] *Department of Construction Economics and Management, University of Cape Town, Private Bag, Rondebosch 7701, Cape Town, South Africa*

Morning commuters on urban South African roads observe dozens of roadside work-seekers displaying signs - or tools - of their construction sector trades, despite a proclaimed national artisan skill shortage. Additionally, all the roadside work-seekers are African men, ostensibly the target group of transformation legislation promoting economic inclusion. Mixed methods were adopted to explore the roadside recruitment practices, namely: unstructured focus groups with roadside work-seekers, semi-structured telephonic interviews with junior and micro contractors (SMECs); and an online focus group with education and training practitioners. A comprehensive strategy for integrated and articulated post-school education and training exists, supported by extensive development of public TVET colleges, offering occupational qualifications. However, the extended employment periods and formal assessments required are not suited to the SMECs, who confirm practices of "on-the-job" training and observational competence assessment. Recruitment by word-of-mouth excludes inter-provincial migrants, and legislation to promote economic inclusion excludes non-citizens. The human capital of roadside work-seekers is undervalued by terminology of "labourer" and "migrant", which have apartheid-era connotations. Discrete skill recognition and coaching skills for supervisors and artisans are advocated for the SMECs; with a revised "roadside contractor" status, and an industry job-completion bonus, such as the fishing sector "agsterskot".

Keywords: labourer, migrant, roadside work-seeker, sub-contractor

INTRODUCTION

As Mxolisi watched the new young bricklayer, he recalled his father teaching him how to lay bricks many years ago in the Eastern Cape. He notes the youth's attitude and willingness to learn - qualities Mxolisi believes are the key to success. After his father's death Mxolisi left the rural area and travelled to Johannesburg, where he joined the roadside work-seekers, displaying signs indicating their skills. As a result of an award-winning initiative: "Men at the Side of the Road" many of the Cape Town roadside work-seekers have tools to identify their trade - rather than signs. Mxolisi subsequently moved to Cape Town, which offered higher daily rates, the company of many fellow isiXhosa-speaking work-seekers, and proximity to his rural home. He formalised his experience and skills by attending a local training college, and started

[1] shammond@iafrica.com

Hammond, S, Bowen, P and Cattell, K (2016) The Roadside Work-Seeker Phenomenon in the South African Informal Construction Sector. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference,* 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 985-995.

his own business. He is now an employer with sufficient means to build his rural retirement home part-time. Mxolisi's success story appears to indicate a means of social mobility, which raises the question why in South Africa (SA) - with a proclaimed scarcity of artisan skills - do so many men remain at the roadside? This study forms part of continuing empirical research into the implementation of skills development in the informal sub-sectors of the construction sector. The dual aims of this study are to ascertain the effectiveness of the strategic intentions of skills development and economic inclusion for the SMECs, and to gain an appreciation of the experiences of roadside work-seekers.

LITERATURE REVIEW

The construction sector is recognized internationally as an entry-level employer of unskilled and semi-skilled labour (Wells 1986, 2007; Ofori 2012; Wells 2012; Odediran and Babiola 2013). South African expectations post-apartheid have been that infrastructure development would benefit economic inclusion by developing emerging contractors and providing employment (Hill et al. 2003; Kraak 2005; CIDB 2009; Ranjit et al., 2011; CIDB 2013, 2015). However, concurrent with the drive for economic inclusion, the local construction industry has followed global trends of informalisation and casualisation of labour (Cheadle and Clarke 2000; Theron and Godfrey 2000; Thompson 2003; Garen 2006) The larger construction companies have evolved into professional project, systems integration and turnkey specialists, with physical construction either pre-produced, or constructed onsite by sub-contractors. The work is further outsourced for procurement of unskilled and semi-skilled labour via labour brokers and “labour-only” contracts (Theron 2005; CIDB 2015, 16, 19). In 2014 labour law amendments (RSA 1995, 1997, 1998) significantly curtailed labour broking, but with potential unintended consequences for skills development implementation see Hammond, Bowen, et al., (2015)).

Ofori (2012) identified the importance of research on the construction sector in developing countries and the positive potential of the sector. However, in the South African context with an apartheid history of exclusion from education and skills, human resource management of an increasingly diverse workforce and concurrent employee development are critical. English (2002) highlighted the importance of cross-cultural communication, and Greef (1990) pointed to the importance of cross-cultural people management by highlighting the attitudes of supervisors classified as “coloured” to the rising African workforce. Toor and Ogunlana (2008:192) identified skills required for multinational personnel management as: decision-making, problem-solving, listening skills, and recommended development of “…cross-cultural leadership competencies…” for inclusion in university programmes. However, the majority of SMECs do not have a tertiary level of education (CIDB 2011).

An additional relevant role of personnel management is recruitment, which for SMECs has been described as informal with recruitment based upon social networks (Lekarapa and Root 2011; Crankshaw 2014). This recruitment process does not take account of formal qualifications or follow professional human resource management recruitment methods, and appears not to have changed despite: the introduction of the skills development infrastructure post 2000 (Cattell 1994; Cattell et al., 1996; Cattell 1997; CIDB 2015), and a number of developmental interventions for emerging contractors (Martins 2005; Lazarus et al., 2006; Hauptfleisch and Verster 2007; Martin 2010).

In many countries the unskilled construction work is "…mainly occupied by migrants…" (CIDB 2015, 16), and particularly in developing countries migrants who seek a livelihood in the urbanized centres "… are increasingly forced to eke out a living on the margins of the urban economy" (Wells 2012, 167). South Africa has a history of migrant labour; following the discovery of diamonds and then gold in the 1800s. During the apartheid era the migrants who were mainly male, were excluded from skilled work and from permanent residence in the urban centres. The migrants were therefore always intended to return "home". Since 1994, legislation has been enacted to promote skills development and economic inclusion (RSA 1998a, b, 1999, 2003, 2008), which will be referred to further as the transformation legislation, and there is a constitutional right to freedom of movement and settlement and to choose a trade or occupation (RSA 1996, s21, s22).

Roadside work-seekers (referred to as "day labourers") have been shown to concentrate in areas of socio-economic development, to be mainly male and of generally low skills, and although significant effort was made to locate approximately 1000 sites nationally and about 45,000 work-seekers, the authors concluded that there was an "element of invisibility" (Harmse et al., 2009, 365). The numbers have increased and the make-up of the population has changed with increasing foreign nationals (Crush, 2011). Recently, Blaauw (2016) identifies the increase in "day labourers" and "foreign migrants", concluding that the structural unemployment will not be addressed by more skills training (Blaauw et al., 2016:6).

RESEARCH METHOD

Purposive sampling identified the categories able to positively contribute to the research as: the roadside work-seekers, SMECs, and ETD practitioners. A general ethical clearance and a clearance specifically for an Online Focus Group was obtained from the University of Cape Town. The 2011 Census was used to identify a geographic area, which fairly closely reflected the national demographic profile.

Roadside work-seekers: Three main work-seeker sites were identified and visited on various week-days before 11h30. Each site consisted of small groups spread out along the roadside. All interviews were conducted and notes taken personally. The researcher was alerted to potential risks to conducting the field research by an ethnographic study by (Sterken 2010) on informal work-seeking noting high levels of suspicion and competition for work. (For a more detailed explanation see (Hammond, Cattell, et al., 2015). Given the context, the format adopted is best described as unstructured focus groups, with additional informal individual interviews. Limited notes were made on site, and more comprehensive reports written up shortly after the engagements. 55 specific individuals could be identified, some of whom may have been included in groups more than once, but were reflected as 1. When engaging with small groups, commonly curious work-seekers joined, while other members left the group discussion after ascertaining no work was on offer. Some members were not counted as they did not volunteer any information. The men were all African: 5 Mozambican, 4 Malawian, 1 Zambian, 27 Zimbabweans, and 18 South Africans (1 from the North West province and the remainder from the Eastern Cape); the ages range from 18 to 39, 2 were in the 15-24 age group, and only 4 above the 25- 34 age group; and all of the men who contributed indicated a minimum primary school education, and the Zimbabweans indicate O and A levels.

Telephonic interviews: The contractors were identified from a publicised register of the Building Industry Bargaining Council members and local service provider

directories. The interviews were semi-structured and conducted either in person or by telephone. Respondents were hesitant to reveal actual number of employees, but after confirmation that the research was confidential it was established that less than 50 covered all respondents. The questions asked related to their methods of recruitment, whether employees are qualified, and how competence is ascertained, and about awareness of available training interventions. Notes were made during and immediately after each call.

Online focus group (OFG): The OFG was conducted on a social network platform in a group visible only to the participants. An invitation was sent to all members of the social network by a broadcast message. An estimated 4,000 may have been received, dependent upon their profile settings on receipt of messages. 32 members indicated a wish to participate and agreed to the conditions, of which 27 finally completed the sign up to the group. The discussions focused on: constraints to implementation of formal qualifications in the informal sector, attitudes to qualifications, what soft skills may be advantageous to the roadside work-seekers, artisan skills and identity formation through apprenticeship, and the level of youth skills.

ETD practitioner survey: Attendees at a conference for ETD practitioners were asked for their opinions on artisan apprenticeships. Although all believed artisan training to be critical for South Africa, they expressed concern regarding the status afforded to artisan trades. All data collected was personally written up in note form and then uploaded to NVivo software for coding and analysis.

Table 1. Summary of group category and qualitative enquiry format

Category	Method Format	
Work-seekers	Unstructured focus groups and informal interviews	n=55
Contractors and industry	Individual interview, telephonic survey and email correspondence	n=29
ETD practitioners	Online Focus Group - confidential, visible only to participants	n=27
ETD practitioners	Survey of artisan conference participants	n=24

DISCUSSION

Work-seeking and recruitment practices

The roadside work-seekers comprise diverse immigrant groups from a wide range of southern and central African countries, with a predominance of Zimbabweans, and a smaller number of internal migrants in the specific sites researched - all African men. There is no indication that this is a representative demographic sample of other sites or regions. However, this research confirms previous findings that many SA citizens tend to wait at home to be called for work via neighbours and friends. When asked whether they recruit roadside work-seekers all the registered contractors indicated that when they require additional labour, they ask their employees to bring in extra workers. However, micro contractors working alone (some of whom are artisans) do utilise the roadside work-seekers. Both the migrant roadside work-seekers and the micro contractors despite being excluded by the transformation statutes, display a mutual interest in earning a living and both groups have tools, skills, and assets they deploy to jointly achieve this purpose.

The statutory exclusion arises from the legislation intended to advance groups previously discriminated against under apartheid. The non-national roadside work-seekers are not included in the definition of “black” in the Employment Equity Act (RSA 1998b). The micro contractors indicate that they prefer working for themselves, and although not articulated, they are also more likely to be excluded from formal employment by affirmative action policies under the same legislation. Additionally,

even the immigrant work-seekers who claim to have residence rights and work permits are excluded from employment in medium to larger construction companies. For the purposes of state tender acquisition, the definition of "black" is also used in the Broad-Based Black Economic Empowerment Act and "scorecard" evaluation (RSA 2003, 2015). The practical implications are that inter-provincial migrant are excluded as they lack the social capital of local employee contacts; non-national migrants are excluded by legislation; and both categories are excluded from the employment necessary for formal qualification acquisition.

Reflecting upon the difference between self-employment and formal employment, some of the work-seekers display the tools of their trade and notices of their skill and mobile phone number, which implies a self-employment contractor relationship. In Marxian terms as Pennel (2016) observes, this hints of a reclaiming of the means of production. What appears to differentiate the micro contractor from the roadside contractor with a sign and tools, is the ability to obtain finance to purchase a vehicle. During one roadside focus group one of the participants indicated that not all the people who drive up with a vehicle are artisans, indicating that some are able to get the work contract and then seek roadside work-seekers with the relevant skills. This arose from questioning seeking information on how the daily "rates" were set. There are specific daily rates per trade, which appear to be highest in Cape Town. The more skilled work-seekers indicated that they appreciate that not all the micro-contractors are able to pay the going rates.

Work-seeking and qualifications

When vehicles pull up at the roadside, workers are regarded as inter-changeable, those willing to join the vehicle are not asked what they are able or qualified to do. As they recount, they have no idea even where they are going, or what they will be required to do. There is an assumption they will be asked to mixed plaster or cement. As a counter to this demeaning behaviour some of the roadside work-seekers appear to use their tools to establish their skilled identity and status. There also appears to be a hierarchy among those displaying tools, the tiler commanding the highest rate. When pressed further the skilled workers deny that they would accept a "labouring" job. The more skilled work-seekers indicate occasional jobs for multiple weeks. The traditional skills most on display at the roadside are: brick-laying, plastering, tiling and painting, with fewer carpenters. The workers indicate that these skills have been acquired by experience and informal training, but particularly in the case of the Zimbabweans from vocational school or training centres. As indicated the Zimbabwean workers all claim to have "O" levels and some "A" levels, and are generally extremely articulate in English - as one roadside work-seeker explained: "we are British".

In interviews where contractors are questioned about "qualified" workers, it becomes clear that the word is used to describe a worker who meets the contractor expectation - not necessarily one who is formally assessed or certificated. For the unskilled and semi-skilled positions, the contractors are more interested in the attitude to work. For example, for micro contractors the level of English language appears to be advantageous. Many of the roadside work-seekers indicate that they were trained by their father, or that their families are involved in the building industry. In the Western Cape, where there are still thatched roof cottages and Cape Dutch architecture, but no formal occupational qualification for thatching, there are a few family surnames associated with thatching - representing a traditional skill passed from father to sons.

The skills development context

Financial and time constraints: The research has identified a number of constraints to implementation of the National Skills Development Strategy (DHET 2011). For the SMECs, the local Master Builders Association has been running a supervisory training programme. The SMECs are unaware of the training, but indicate that they cannot afford to attend training either financially or in terms of lost time. The training programmes that do receive approval are those that cover new technologies and new openings for tenders, contracts, and employment. Two identified are solar panel installation, and asbestos removal. A recent programme funded by the Department of Labour Unemployment Insurance Fund with the Energy and Water Sector Education and Training Authority to train unemployed persons as solar installers experienced a 97% success rate (Ramutloa 2016). By contrast, a comparable CETA learnership programme reported lack of commitment by learners (Mummenthey and Du Preez 2010).

Emphasis on formal qualifications: The introduction of the Quality Council for Trades and Occupations (QCTO) introduced a new qualification and curriculum format. Whereas the previous "unit standard" (US) based system allowed credits against an individual US, the new format emphasises full qualifications. Although the development of occupational qualifications ostensibly adopts a consultative process involving professional bodies, academics, and subject- matter experts, the persons who are invited and are able to attend and contribute to the process are not representative of the SME contractors. One further aspect is that Recognition of Prior Learning has not been effectively implemented. There is no incentive for employers to promote formal qualification recognition as this may imply an increased wage rate. For individuals the process of drawing up a portfolio and being assessed would be unaffordable. The roadside work-seekers and sub-contractors are not aware of the RPL process, nor of the recognition of international qualifications via the South African Qualification Authority (SAQA).

Table 2: Construction sector participation in skills development

Number of employees	0-49	49-149	150+	Total
Paying Skills Levy (SDL)	1735	808	55	1970
Submitting WSP and ATR	294	129	53	476
Percentage	16.9	16	96.4	24.2

(CETA, 2014)

Lack of participation. Employers with an annual payroll in excess of R500 000 per annum are required to pay a skills levy of 1% of annual payroll (SDL) to the South African Revenue Service (SARS). The low participation in annual reporting (training planned = WSP and undertaken = ATR) to the Construction Education and Training Authority (CETA) precludes the SDL-paying contractors from access to the SDL refund or discretionary funding of apprenticeships and learnerships. The following table indicates that it is the largest companies of more than 150 employees that benefit most from the skills levy funding.

Public TVET Colleges: The OFG raised integration of trade test centres into public TVET colleges as a constraint. The previous "building training centres" were run by builders and staffed by trainers, who were time-served artisans. The older artisans trained and passed on skills and knowledge, when the physical work became taxing. The artisan skills shortage allows current artisans to command a much higher rate of pay than the TVET institutions are able to afford. The outcome described is that the current trainers are not experienced artisans and do not have the necessary level of

practical expertise. The focus is on theory and passing on of knowledge rather than practical skill. One training provider observed: "… the bricklayers don't need to understand who Pythagoras was, or his theorem to apply the 3:4:5 rule to construct 90 degree corners". Finally, in recently the value of the TVET qualification has been identified as not questioned providing any additional income vis-à-vis a school-leaving certificate (Bhorat et al., 2016).

CONCLUSIONS

Informalisation and organisational restructuring of the construction sector are international trends, but this study suggests the relevance of the South African historical context. Formal occupational qualifications: The national skills development strategy aims to increase economic participation and inclusion. However, this strategy occurs against a global backdrop of rapid technological advance and reduced formal employment. A recent report on the construction sector suggests that employers: "… distanced themselves from the public institutions…" (Lolwana et al., 2015, 34) - referring to the public TVET colleges. However, as the OFG participants suggest, this "distancing" may be an indication of the inappropriateness of the formal college structure and formal occupational qualifications for the industry requirements. The CETA statistics confirm the lack of participation of other than the largest companies, and sub-contractor interviews confirm lack of recognition of qualifications. The largest companies appear to be benefitting disproportionately from the skills levy system.

Formal qualifications are required for infrastructure construction, and heavy industries such as mining, with stringent health and safety legislative requirements. However, Charman and Petersen (2016) have identified a previously unrecognised growth in the informal sector, which may be anticipated to increase with the continued urbanisation. From the research data to date, where on-the-job-training persists and competence exists in the eye of the contractor, the most useful focus would appear to be coaching skills for supervisors and artisans, to pass on their knowledge and skills. Extension of the current qualification format uniformly across all sectors and levels would appear to be inappropriate. The construction sector may be differentiated vertically from other sectors, and horizontally separating the SMECs. At the lower level the "building block" credit accumulation of the previous unit standards and recognition of prior skills acquired appears to be more appropriate, rather than full occupational qualifications.

The nature of employment relationships: The SMEC sub-sector of construction remains a source of work and income, although not in the format of formal employment. Additionally, the micro-contractors and roadside work-seekers appear to have a symbiotic relationship of the mutually excluded. This suggests a relationship along a continuum somewhere between that of a formal contract of employment and an independent sub-contractor, by definition a different form of contract (Hagiu 2015), such as a "roadside contractor". Provision of social security: Peripatetic work and periods of non-work exclude traditional deductions for industry sick leave, holiday, or retirement funds, tax, and social security. Securing a continuous income stream is a concern for the intermittently employed unskilled and semi-skilled workers, as well as the micro-contractors. A suggestion that may improve the economic status of labour is the adoption of an end of project or work bonus, such as payments in agriculture, or the fishing sector "agsterskot" paid after the catch has been sold. Retrenchment from formal employment attracts a severance

payment - in SA labour law calculated at one week of pay for each completed year of service. An end-of-contract bonus could be calculated at the prevailing regional rates.

Finally, as the introductory paragraph indicated, there has been some progress on social mobility. However, race remains the dominant focus rather than class, although it is the working class who still reside in segregated townships - as do the roadside work-seekers. The terminology of "day labourers" to describe the work-seekers harks back to an apartheid era where black people were excluded from skilled occupations. Many of the work-seekers have acquired skills by both training and experience. Equally, the nature of the migrants has changed: many of the work-seekers interviewed have been in SA for extended periods and are family men here with their wives and children. From a human capital perspective, the unemployment and under-employment represents a significant loss to the SA economy, although needs to be placed in context against unemployment rates nationally and in the region of the research of 26.7%, and 20.9%, respectively (StatsSA 2016). In conclusion, in the informal construction sector there appears to be minimal change in life circumstances of the participants despite the post-apartheid political and skills development dispensations.

REFERENCES

Bhorat, H, Cassim, A and Tseng, D (2016) Higher education, employment and economic growth: Exploring the interactions. Development Southern Africa, 33(3), 312-327.

Blaauw, P, Pretorius, A and Schenck, R (2016) Day Labourers and the role of foreign migrants: for better or for worse? Econ3x3. Available from http://www.econ3x3.org/article/day-labourers-and-role-foreign-migrants-better-or-worse [Accessed 26th June 2016].

Cattell, K S (1994) *Small Black Builder in South Africa Problems and Prospects*. Cape Town: University of Cape Town.

Cattell, K S (1997) *The Development of Black South African Small-Scale Construction Enterprises. Emerging Contractors and the Demand for Formal Training*. Cape Town: University of Cape Town.

Cattell, K S, Hindle, R D and Rogalli, H (1996) South Africa's emerging building firms: A vocational training challenge. *In*: *Proceeding of International Conference on Construction Modernisation and Education (CIB W89*), 21-24 October, Beijing, *China*, CIB.

Charman, A and Petersen, L (2016) *A Growing Informal Sector: Evidence from a Enterprise Survey in Delft*. Econ3x3. Available from http://www.econ3x3.org/article/growing-informal-sector-evidence-enterprise-survey-delft [Accessed 26th June 2016]

Cheadle, H and Clarke, M (2000) *International Labour Organisation National Studies on Workers' Protection: South Africa*. Cape Town: ILO.

CIDB (2009) *Application for Contractor Registration - Grades 2-9. V3.6*. Pretoria: CIDB.

CIDB (2011) *Contractor Skills Survey*. Pretoria: CIDB.

CIDB (2013) *Standard for Developing Skills through Infrastructure Contracts, BN180, GG No. 36760*. Pretoria: RSA, 84-101.

CIDB (2015) *Labour and Work Conditions in the South African Construction Industry*. Pretoria: CIDB.

Crankshaw, O (2014) Causal mechanisms, job search and the labour market spatial mismatch. *Journal of Critical Realism*, **13**(5), 498-519.

Crush, J (2011) Complex movements, confused responses: Labour migration in South Africa. Cape Town: SAMP.

DHET (2011) *National Skills Development Strategy III*. Pretoria: RSA.

English, J (2002) The communication problems experienced by workforce on-site, and their possible solutions. *Journal of Construction Research*, **3**(02), 311-321.

Garen, J (2006) Use of employees and alternative work arrangements in the United States: A law, economics, and organizations perspective. *Labour Economics*, **13**(1), 107-135.

Greef, D (1990) *The Attitudes Of Coloured Supervisors To The Upward Mobility Of Africans In The Building Industry In The Western Cape*. Research report in fulfilment of MBA. GSB, University of Cape Town.

Hagiu, A (2015) *Companies Need an Option between Contractor and Employee*. HBR https://hbr.org/2015/08/companies-need-an-option-between-contractor-and-employee [Accessed 21st August]

Harmse, A, Blaauw, P and Schenck, R (2009) Day labourers, unemployment and socio-economic development in South Africa. *Urban Forum*, **20**(4), 363-377.

Hauptfleisch, A C and Verster, J J P (2007) Mentoring: A key intervention in small construction contractor capacity building in South Africa. *In*: D Boyd (Ed.) *Proceedings 23rd Annual ARCOM Conference, 3-5 September 2007, Belfast, UK*. Association of Researchers in Construction Management, Vol. 1, 33-42.

Hill, R C, Pienaar, J, Bowen, P A, Kusel, K and Kuiper, S (2003) The transition to sustainability in the planning, construction and management of the built environment in South Africa. *International Journal of Environmental Technology and Management*, **1**(4), 200.

Kraak, A (2005) The challenge of the 'Second Economy' in South Africa: The contribution of skills development. *Journal of Vocational Education and Training*, **57**(4), 429-452.

Lazarus, S, Hauptfleisch, A C D and Verster, J J B (2006) The development and assessment of an integrated skills development model for emerging construction contractors. *Acta Structilia*, **13**(2), 145-158.

Lekarapa, M and Root, D (2011) Investigating Informal Social Networks among Construction Artisans in South Africa. *In*: *Proceedings of 7th CIDB Post Graduate Conference on Construction Industry Development*, 9-11 October, University of Pretoria, South Africa. University of Pretoria: CIDB.

Lolwana, P (2015) The role of stakeholders in the transformation of the South African higher education system. *In*: S Schwartzman, R Pinheiro, P Pillay (Eds.) *Higher Education in the BRICS Countries: Investigating the Pact between Higher Education and Society*. New York: Springer.

Martin, L (2010) Transfer mechanisms of knowledge and skills in co-operations between emerging and established civil engineering contractors. PhD Thesis, Cape Town. Cape Peninsula University of Technology.

Martins, J (2005) The state of skills training in very small and microenterprises in the South African environment. *South African Journal of Labour Relations*, 33-58.

Mummenthey, C and Du Preez, R (2010) Implementing efficient and effective learnerships in the construction industry. *SA Journal of Industrial Psychology North America*, **36**(1), 766-950.

Odediran, S J and Babiola, O (2013) Employment structure of informal construction workers/artisans in Nigeria. *Global Journal of Management and Business Research*, XIII(XI), 25-40.

Ofori, G (2012) The construction industries in developing countries: Strategic review of the book. *In*: G Ofori (Ed.), *New Perspectives on Construction in Developing Countries 1st Edition*. Abingdon, Oxon: SPON Press, 1-15

Pennel, D (2016) *Back To The Future…The Future Of Work Is Beginning To Look Increasing Like The Past*. *In*: ADAPT International Bulletin, Bergamo, Italy: ADAPT and CIETT, 2.

Ramutloa, L (2016) *291 Graduate Solar Installers from Labour department & EWSETA UIF funded programme*. Available from http://www.skills-universe.com/group/resolving-youth-unemployment/forum/topics/291-graduate-solar-installers-from-labour-department-ewseta-uif-f. [Accessed 26th June 2016]

Ranjit, V, Mwanaumo, E and Nkado, R (2011) A strategy for change: Contractor development. *In*: *Proceedings of 7th CIDB Post Graduate Conference on Construction Industry Development, 9-11 October, University of Pretoria, South Africa*. University of Pretoria: CIDB.

RSA (1996) Constitution of the Republic of South Africa Act 108 of 1996. *In*: *GoN 2083*, Pretoria: RSA.

RSA (1998a) The Skills Development Act 97 of 1998. *In*: GoN 1400, *GG No. 19420*, Pretoria: RSA.

RSA (1998b) Employment Equity Act 55 of 1998. *In*: *GoN 1323, GG No. 19370*, Pretoria: RSA.

RSA (1999) Skills Development Levies act 9 of 1999. *In*: *GoN 516, GG No. 19984*, Pretoria: RSA.

RSA (2003) Broad-based Black Economic Empowerment Act 53 of 2003. *In*: *GoN 17, GG No. 25899*, Pretoria: RSA.

RSA (2008) National Qualifications Framework Act 67 of 2008. *In*: *GoN 167, GG No. 31909*, Pretoria: RSA.

RSA (2015) Broad-based black Economic Empowerment Act: Code of good practice amendments. *In*: *GN407, GG No.38765*, Pretoria: RSA.

StatsSA (2016) *Quarterly Labour Force Survey*. Pretoria: StatsSA, 133.

Sterken, H (2010) 'Boundary *Work' In The Process Of Informal Job Seeking: An Ethnographic Study Of Cape Town Roadside Workseekers*. Masters in Anthropology, Humanities, University of Cape Town.

Theron, J and Godfrey, S (2000) *Protecting Workers on the Periphery*. Cape Town: Institute of Development and Labour Law, UCT.

Theron, J P (2005) Intermediary or employer? Labour Brokers and the triangular employment relationship. *Industrial Law Journal*, 26 April (4), 618-649.

Thompson, C (2003) The changing nature of employment. *Industrial Law Journal*, 24(October).

Toor, S-u-R and Ogunlana, S O (2008) Leadership skills and competencies for cross-cultural construction projects. *International Journal of Human Resources Development and Management*, **8**(3), 192-215.

Wells, J (1986) *The Construction Industry in Developing Countries: Alternative Strategies for Development*. Beckenham: Croom Helm.

Wells, J (2007) Informality in the construction sector in developing countries. *Construction Management and Economics*, **25**(1), 87-93.

Wells, J (2012) Informal construction activity in developing countries. *In*: G Ofori (Ed.) *New Perspectives on Construction in Developing Countries*. Abingdon, Oxon: SPON Press, 166-181.

SOCIAL PROCUREMENT AND EMPLOYMENT REQUIREMENTS IN CONSTRUCTION

Daniella Petersen[1] and Anna Kadefors[2]

[1] *Technology Management & Economics, Chalmers University of Technology, SE-412 96 Gothenburg, Sweden*

[2] *KTH Royal Institute of Technology, SE-100 44, Stockholm, Sweden*

Today social procurement, and requirements to create employment for disadvantaged groups in particular, are increasingly used in the construction sector. In Sweden, a growing interest in social procurement and employment requirements is partly due to problems with segregation and high unemployment rates among immigrants. As a result, many municipalities and landlords see opportunities to combine construction projects with employment opportunities for tenants. Simultaneously, prognoses state that building will be booming in Sweden the upcoming years, creating new drivers for the construction industry to search for new employees among new groups in society. However, research on the implementation and effects of social employment requirements on organizations in the construction sector is scarce and mainly descriptive. This paper aims to address this recent trend in construction procurement and the implications for the sector as well as for research. Previous research on social procurement and employment requirements in the construction industry and written material on three Swedish cases serve as a basis for the discussion. Findings suggest that the changes in the construction industry can be understood as an ongoing institutionalization process, where the institutional work of procurement- and construction actors are reshaping old institutional logics towards a more socially service-oriented sustainable industry.

Keywords: employment requirements, institutional change, social procurement

INTRODUCTION

The concept of social sustainability is increasingly in focus in the construction sector, partly because procurement criteria are moving from the traditional emphasis on quality and price of the product to increasingly address secondary environmental and social objectives (Ruparathna and Hewage 2015). Social procurement, defined as "the use of purchasing power to create social value" (Barraket and Weissman 2009, p. iii), encompasses a range of issues and goals relating to various dimensions of social value: health and safety, buying from local SMEs, buying from women- and minority owned businesses, and employment creation for disadvantaged groups like ex-convicts, ethnic minorities, the disabled or the long-term unemployed (e.g. Walker and Brammer 2012; Zuo *et al*., 2012; Dean, 2013; Loosemore 2016).

In Sweden, this latter goal has been particularly in focus the last years, now gaining more attention in the industry than more established goals of ecological sustainability. The background is that Sweden experiences problems with segregation, where

[1] daniella.petersen@chalmers.se

Petersen, D and Kadefors, A (2016) Social Procurement and Employment Requirements in Construction. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 997-1006.

immigrants have considerably higher unemployment rates than the domestic population. This is further aggravated by the current refugee crisis creating a large inflow of immigrants (Bennewitz 2016a). At the same time, the 1960s residential buildings where most immigrants live are in need of refurbishment. Many municipalities and landlords now see opportunities to combine these construction programs with requirements for suppliers to offer employment for the inhabitants (Bennewitz 2016a; Sveriges Byggindustrier 2016a; Åkerlund 2016). Simultaneously, building in Sweden is expected to boom in the upcoming years, much due to political goals to meet a severe shortage of housing. However, the Swedish construction industry is already today experiencing a shortage of capacity, and a lack of construction workers in particular (Sveriges Byggindustrier 2016b). This combination of high demand for construction, unemployed immigrants and high inflow of new citizens has generated partly new drivers for social procurement and employment-creating requirements.

The aims of this paper are to map the effects of the recent trend of increased use of social employment requirements in procurement for the organizations that are active on the buyer and supplier sides in the construction sector, and to discuss relevant research approaches to understand this development. The focus is on organizational aspects such as how roles, processes, competences and strategies are affected. The study is literature-based and the paper is organized as follows: first, previous research and industry and government publications on social procurement and employment creation in the construction industry is summarized. Then, three Swedish cases are described, also based on literature sources, and related to the literature review. Finally, the use of institutional theory as a basis for a theoretically informed discussion of social procurement and employment requirements is discussed.

OVERVIEW OF THE INTERNATIONAL LITERATURE

In the international context social procurement is not new. In a historical overview, McCrudden (2004) map linkages between procurement social policy from the 19th century until today, and found that social procurement has a long history, especially in the building sector, where employment for disadvantaged groups has been one of the main areas of consideration. Such tendering policies have been used in the US for a long time, e.g. with affirmative action, and are now, with legislation such as the UK Social Value Act from 2012 and EU directives, increasingly being used throughout Europe (Furneaux and Barraket 2014). In Australia as well, public construction projects include employment opportunities for Australian indigenous people (Loosemore 2016). In effect, construction is often perceived as one of the industries more suitable for implementing social procurement (Almahmoud and Doloi 2015; Sutherland *et al*., 2015). However, despite that social procurement has frequently been applied to construction, construction clients are not considered strong in promoting sustainability (Ruparathna and Hewage 2015), and the industry is perceived as lagging behind other sectors in their implementation and experimentation with socially responsible concepts (Loosemore 2015). Whyte and Sexton (2011) claim that the construction industry more generally is struggling to radically transform in order to address increased social, environmental, financial and demographical challenges.

Social procurement using employment requirements may have important implications for both procuring organizations and suppliers. On the procurer side, use of soft, non-price criteria has been associated with a trend towards increased professionalization

and centralization of procurement functions in public entities (Sporrong and Kadefors 2014). Such criteria are more complex to define and evaluate than traditional price-related criteria, and therefore raise competence requirements and collaboration needs within client organizations. A relationship between competence and procurement practice has been documented also for employment requirements. In a combined interview and survey study, Sutherland *et al*., (2015) found that those not using employment requirements perceived such requirements not relevant for their projects, but also reported insecurity as to how to manage the requirements, seeing them as too labour- and resource intensive. They also experienced uncertainty regarding the legal application of employment requirements, generally lacked a dedicated employment requirement procurer, and feared that such requirements would impact the price of contracts or the quality of tendering contractors.

As for those procuring entities that had engaged in social procurements, the study by Sutherland *et al*., (2015) showed that they instead emphasized the potential to contribute to fulfilling organizational, local and national outcomes/goals, and to encourage innovation in service delivery or to build stronger relationships with contractors and local communities. More than half of them had a specific procurer being responsible for the employment requirements. Further, in a study of the Women in Construction-project, aimed at promoting women in the construction of the Olympic Park in London, Wright (2015) found that the UK Social Value Act from 2012 not only regulated that social considerations should be made, but also spurred a more consistent approach from clients on social value requirements and monitoring.

Employment requirements in construction procurement also potentially impact processes and management systems on the supplier side. Wright (2015) found that social value can be a part of organizations' CSR work, and that many contractors expressed an ethos of helping people in the community. In addition, such social commitment provides recognition outward to clients and main contractors. Accordingly, Sutherland's *et al*., (2015) results suggest that contractors are becoming increasingly positive towards social procurement and employment requirements, and that working with such requirements now have become "business as usual" for many contractors in Scotland, thus supporting Wright's (2015) findings of a more consistent approach to social procurement. In fact, Sutherland *et al*., (2015) even found that many contractors were anticipating and preparing for increased use of employment requirements by hiring dedicated social procurement coordinators, adopting employment requirements in relation with their subcontractors, and by involving support office functions to also work with employment creation and to collect data on requirement delivery and impact for future tenders. Likewise, when Zuo *et al*., (2012) interviewed industry professionals about social sustainability, they found that contractors are willing to make social considerations in their projects.

One way to fulfil employment requirements in social procurement is through contracting social enterprises. Social enterprises are hybrid organizations that have dual goals of social and financial sustainability, thereby aiming to fulfil social purposes like employing marginalized and disadvantaged groups, as well as financial purposes, by distributing profits back to the community and other beneficiaries rather than to shareholders. In the UK and Australia, for example, social enterprises are growing in numbers (Barraket and Weissman 2009; Loosemore 2015). Loosemore (2015, 2016) has conducted studies on social enterprises active especially, but not exclusively, in construction. An interview study (Loosemore 2015) revealed a lack of trust from contractors, as well as from some clients, who rather choose traditional

subcontractors whose business models are more easily understood. However, engaging social enterprises was also found to serve as a way for contractors and clients to fulfil their CSR minimum agenda. A later case study (Loosemore 2016) showed that clients and contractors have an important role to play in increasing opportunities for social enterprises.

This previous research suggests that increased use of social procurement and employment requirements has led to new roles, organizations, routines and relationships, such as social procurement coordinators, social enterprises, and deeper collaboration between procurement and construction organizations. In the following section three cases of employment requirements in Swedish construction procurement are reviewed.

THREE SWEDISH CASES

The cases were chosen for several reasons. Firstly, these cases are well known from media coverage and have also been studied and evaluated to some extent, by both industry professionals and researchers. The research that has been conducted has however focused mainly on socio-economic effects and benefits of social procurement and employment requirements, and not on organizational implications. Secondly, the cases represent three different models for how to conduct social procurement using employment requirements, and thereby provide an overview of current Swedish practices. However, it should be noted that the cases are not representative of all models used.

Case 1: A public housing company

A renovation project in Örebro, Sweden, called Vivalla, is one of Sweden's most talked-about social procurement construction projects (Bennewitz 2016a). In 2013, a public housing company established a four-year strategic partnership with the contractor Skanska and the Employment Agency to renovate an underprivileged neighbourhood, which suffered from high unemployment. The housing company received funding from a national urban development organization in order to find new solutions and practices for ecological, social and economic sustainability. The aims of this project were to (1) provide unemployed tenants with work opportunities through internships and employment within either Skanska, the housing company, or some other project partner or subcontractor, (2) to provide education and language training with the aid from the Employment Agency, and (3) to gain knowledge about how to work with social sustainability and recruitment in future projects (Ghadban *et al*., 2015).

The project was designed so that the Employment Agency helped recruit tenants and paid for the internship period, while Skanska demanded that each project member (including subcontractors and consultants) hired at least one intern, who could be offered employment after internships ended. In addition, training was organized for those responsible for supervising the interns. According to the sustainability manager of Skanska, which has additional employment initiatives like leadership programs for immigrant engineers, the main takeaway from the project was deeper learning about social sustainability and increased insight into how to recruit new employees (Ghadban *et al*., 2015). In 2015, two years after the project was started, 50 people had gained internships and even though initial investments were higher due to the employment requirements, the project had generated more than 1 MEUR in public value for the housing company and the Employment Agency. Considering the large

profits from the Vivalla project, the lack of employment requirements in Sweden has been interpreted as due to municipalities' short-term perspectives, as well as bureaucratic difficulties (Bennewitz 2016b).

Case 2: A private housing company

In order to promote the City of Malmö's new economic, environmental and social sustainability agenda, the City has held workshops with major housing companies. As response, the private housing company Trianon decided to build new housing and renovate part of its housing stock in a disadvantaged neighbourhood using employment requirements. The neighbourhood struggled with low education levels, low income and high unemployment among tenants. The housing company collaborated with the consultancy firm WSP, who provided support for e.g. employment creation management. The housing company, assisted by the Employment Agency, demanded that the main contractor, PEAB, would hire 10 people per year for four years in the project. If they would fail to comply they would receive fines of approximately 10 000 EUR. Subcontractors were required hire at least 1-2 people, which for some smaller subcontractors was risky (Balkfors *et al*., 2015; Hauksson *et al*., 2015).

Moreover, the housing company also collaborated with the City of Malmö, who gave a 10-year discount on their ground leasing costs as long as the company continue to contribute to employment creation. Thereby the City of Malmö traded short-term profits in the form of leasing revenues for long-term tax revenues from the newly employed. In addition, with help from the municipality the company also received EU funds to decrease energy use in the housing stocks (Balkfors *et al*., 2015). For the housing company, the City of Malmö's sustainability agenda was translated into a commercially driven initiative, as the private company saw a clear alignment between environmental, financial and social goals. When tenants earn wages, education and experience through working in the project, rent payments are ensured. Also, now when the property's janitors are living in the neighbourhood, vandalism in decreased, raising the housing stock's value further (Hauksson *et al*., 2015).

In order to launch this project, the new collaborations involving the housing company, the consultancy firm, the City of Malmö's different institutions, the Employment Agency etc. were important. Furthermore, many organizations had to forgo their normal working practices in order to help the housing company realize the project. For example, the housing company had to approach construction procurement in a new way, the contractors had to accommodate increased education needs for the newly employed, and different government organizations such as the Employment Agency and Social Services had to develop coordination between the different organizations (Balkfors *et al*., 2015; Hauksson *et al*., 2015).

Case 3: A municipal policy

The City of Gothenburg has a social procurement policy emphasizing social integration, employment creation, fair work and fair employment contracts. Since 2014 the City of Gothenburg has set the goal that 50 % of all publicly procured services should include social requirements, however, social requirements have mostly been used for construction contracts (The city of Gothenburg 2016a) especially by public housing companies requiring that their tenants are employed in the projects (Balkfors *et al*., 2015; Svensson, 2015). Requirements should also prioritize groups that are far from the labour market and collects welfare, like local immigrants, youths, and disabled (The City of Gothenburg 2016a). These workers should preferably be

hired on short-term employment contracts rather than internships (The city of Gothenburg 2016a). Targeted projects should last for at least four months, and all eligible projects should recruit one prioritized person per ten employees (The city of Gothenburg 2016b).

Based on the results and suggestions of a social procurement pilot study conducted by the City of Gothenburg during 2013-2015 (The city of Gothenburg 2016a), a municipal support function has been established to coordinate and support (1) the procuring organization, (2) the unit responsible for recruitment, which consists of different labour market actors such as the Employment Agency, and (3) the suppliers. The support function and these three groups work together in order to forecast recruitment opportunities and needs, design employment requirements, find and educate possible recruits, follow-up on recruits, etc. However, as additional support the main contractor is required to have a dedicated HR professional responsible for this type of employment requirement, as well as the support function hiring a new communicator in order to help educate clients and suppliers in social procurement (The city of Gothenburg 2016b). The results and suggestions of the study are currently being evaluated (The city of Gothenburg 2016a).

CASE DISCUSSION

Firstly, in previous research the drivers for using social procurement and employment requirement range from altruistic goals such as ethical considerations and CSR (Loosemore 2015; Wright 2015) to more commercial goals such as goodwill, better relationships between clients and suppliers, to regulatory requirements (Sutherland *et al*. 2015; Wright 2015). Drivers mentioned in the Swedish cases include reducing unemployment, learning about social procurement and employment-creating practices, lower maintenance costs, reduced welfare costs, and opportunities for recruitment. Thus, Swedish drivers are fairly similar to those identified in previous international research, although there seems to be less emphasis on CSR aspects and more on the commercial side. Further, an urgent recruitment need is not identified as a driver in international literature, and only to a limited extent in the Swedish cases described here. This development is too recent to be reflected in literature, but seems to increase as a commercial driver for contractors who now must decline projects due to lack of resources, thereby losing business opportunities.

Secondly, the international literature indicated that new roles, relationships and practices are taking form. Sutherland *et al*., (2015) describe how Scottish contractors and suppliers now are changing their business to accommodate the increasing use on employment requirements. Moreover, social enterprises are changing how businesses are usually managed and perceived, creating a new type of role and collaboration partner in the construction industry (Loosemore 2015 2016). We find similar indications in the three Swedish cases, where existing actors, primarily municipalities, housing companies, the Employment Agency and suppliers collaborate in new ways. Also, new types of actors are established, such as support functions. Further, consultancy firms and HR functions develop new services and competences. These new roles, organizations and practices suggest that organizations in the construction sector could be profoundly affected by this development, and need to think differently about the focus of construction procurement and the services provided (Balkfors *et al*., 2015; Ghadban *et al*., 2015; Hauksson *et al*., 2015; The City of Gothenburg 2016ab).

Social procurement as an institutionalization process

The review of literature on social procurement and employment requirements shows that there are few in-depth studies, and that those that exist are mainly descriptive and not strongly orientated towards theoretical development. This does not only apply to construction, but also to social procurement in general, where several authors have pointed at a general lack of conceptualization and limited theoretical examination (Walker and Brammer 2012; Amann *et al*., 2014; Loosemore 2016). Also, even though social procurement has a high profile on the policy level, there is little knowledge of how social procurement policies in general are implemented and embedded in daily procurement practices among procurement professionals worldwide (McCrudden 2004; Walker and Brammer 2012). Although many procuring organizations are familiar with the concept of social procurement there is a lack of tools for how to procure using social requirements (Harlock 2014). Ruparathna and Hewage (2015) further note that there is currently little research into emerging construction procurement trends more generally. Furneaux and Barraket (2014) suggest that studies of social procurement and its policy implementation are impeded by the ongoing debate about the meaning and construct of the phenomenon, and urge researchers to stop debating definitions and instead discuss more empirically interesting topics.

Our literature review shows that social procurement in the form of employment requirements may have important effects for many actors in the construction sector, and frequently leads to a development of new actors, roles, business models and relationships. Construction projects are increasingly seen as a vehicle for achieving secondary objectives and change in wider society. In any field, there are there are institutional logics, or sets of "material practices and symbolic constructions" (Friedland and Alford 1991) which shape meanings, appropriateness and legitimacy, determine issues, problems and solutions, and impact on change (Thornton 2002). Institutional logics have been studied in a vast range of empirical environments, and used both as theory and as a method of analysis (Thornton and Ocasio 2008).

This could be a fruitful approach to studying change processes in the construction industry, which is potentially moving from a logic focused on delivering physical buildings and construction services based on lowest price to an increased focus on delivering social value and services to communities. Several institutional logics may co-exist in parallel for a long time, and change often originates in conflicts and contradictions between such different institutional logics (Friedland and Alford, 1991). The new roles, relationships and routines between market and government organizations suggest that a process of experimentation and learning is taking place, where different approaches to social procurement and employment creation are tested and potentially further disseminated. It is interesting to follow whether these recent developments will impact more profoundly on the culture of the industry, which has historically been struggling to fully embrace more sustainable concepts (Whyte and Sexton 2011; Loosemore 2015; Ruparathna and Hewage 2015).

In such an institutional perspective, these changes could be instigated by professionals performing work related to procurement and construction, who then could be seen as simultaneously conducting institutional work. Institutional work means that individual and collective actors actively and purposively take part in institutional maintenance, disruption and creation. Institutional work is therefore concerned with how actors work on a day-to-day basis and how they change, manage, destroy or

create institutional structures in which they work and live, and how this constructs their relationships, roles and habits emerging (Lawrence *et al*., 2011). The activities and structures studied in research on institutional work have much in common with the changing roles and routines identified in the construction industry. As such, one potential approach for studying what, how and why role and routine changes are occurring as an effect of social procurement and employment creation in the construction industry, is through an institutional work perspective.

CONCLUSION

After reviewing previous literature and three Swedish cases, we suggest that the use of social procurement and employment requirements in the construction industry potentially can be understood as a process of institutional change. There are indications of a deinstitutionalization process of old institutional logics and practices in the construction industry which is driven by political pressures like the EU directives, functional pressures like lack of resources, and social pressures like demand for CSR (Oliver 1992). This implies that a traditional logic, where value is perceived as a function of the cost and quality of the physical product, is increasingly co-existing and competing with a logic where social value plays an important role. If looking through an institutional perspective, these changing institutional logics are subsequently shaped by procurement- and construction actors, and their ongoing institutional work, thereby creating new roles, routines and relationships in the process. By adopting a perspective of institutional logics and institutional work in studying social procurement and employment requirements, research in this field may be more closely related to and informed by relevant developments in the wider academic community.

REFERENCES

Almahmoud, E and Doloi, H K (2015) Assessment of social sustainability in construction projects using social network analysis. *Facilities*, **33**(3/4) 152-76.

Amann, M, Schaltegger, S, Burr, R, Roehrich, J K, Eßig, M and Harland, C (2014) Driving sustainable supply chain management in the public sector. *Supply Chain Management: An International Journal*, **19**(3), 351-66.

Balkfors, A, Grander, M and Stenquist, B (2015) Hållbara renoveringar med Malmö som exempel (Sustainable renovation with Malmö as an example). *In:* H Lind and K Mjörnell (Eds.) Social hållbarhet med focus på bostadsrenovering: En antologi (Social sustainability with focus on housing renovation), 119-28. Borås: Responstryck.

Barraket, J and Weissman, J (2009) *Social Procurement and Its Implications for Social Enterprise: A Literature Review*. Working Paper No. CPNS 48. The Australian Centre for Philanthropy and Non-profit Studies. Brisbane: Queensland University of Technology.

Bennewitz, E (2016a) Sociala Krav Blir Vanligare Inom Bygg (Social Requirements Becomes More Common in Construction). Byggindustrin, May 20th.

Bennewitz, E (2016b) Lönsamt Att Ställa Sociala Krav Vid Upphandling (Profitable To Pose Social Requirements in Procurement). Byggindustrin, May 20th.

The City of Gothenburg (2016) *Social hänsyn i Götebrogs Stad (Social sustainability in the City of Gothenburg)*. Available from http://socialhansyn.se/vad-ar-social-hansyn/social-hansyn-i-goteborgs-stad/

The City of Gothenburg (2016) *Så Fungerar Det Stegvis (This Is How It Works Step By Step)*. Available from http://socialhansyn.se/wp-content/uploads/2014/07/Mittuppslag-folder-2015-webb.jpg.

Dean, A (2013) *Tackling Long-Term Unemployment Amongst Vulnerable Groups*. OECD Local Economic and Employment Development (LEED) Working Papers. OECD Publishing.

Friedland, R and Alford, R R (1991) Bringing society back. In W.W. Powell and P.J. DiMaggio (Eds) *Symbols, Practices and Institutional Contradictions: The New Institutionalism in Organizational Analysis*. Chicago: University of Chicago Press.

Furneaux, C and Barraket, J (2014) Purchasing social good(s): A definition and typology of social procurement. *Public Money and Management*, **34**(4) 265-72.

Ghadban, R, Wedin Hansson, L and Mawlayi, F (2015) En byggentreprenörs erfarenhet av renovering med social hållbarhet: Exemplet Vivalla (A contractor's experience of renovation with social sustainability: The example Vivalla). *In:* H Lind and K Mjörnell (Eds.) Social hållbarhet med focus på bostadsrenovering: En antologi (social sustainability with focus on housing renovation), Borås: Responstryck, 129-32.

Harlock, J (2014) *From Outcomes-Based Commissioning To Social Value? Implications for Performance Managing the Third Sector. Working Paper No. 123*. Third Sector Research Centre. Birmingham: University of Birmingham.

Hauksson, C, Johnsson, L, Sandén, B and Bosaeus, M (2016) Social hållbarhet kräver samverkan: Exempel från miljonprogramsområden i Malmö, Eskilstuna and Landskrona (Social sustainability demands collaboration: Examples from million program neighbourhoods in Malmö, Eskilstuna and Landskrona). *In:* H Lind and K Mjörnell (Eds.) Social hållbarhet med focus på bostadsrenovering: En antologi (Social Sustainability with Focus on Housing Renovation), Borås: Responstryck, 103-118.

Lawrence, T, Suddaby, R and Leca, B (2010) Institutional work: Refocusing institutional studies of organization. *Journal of Management Inquiry*, **20**(1), 52-8.

Loosemore, M (2015) Building a new third construction sector through social enterprise. *Construction Management and Economics*, **33**(9), 724-39.

Loosemore, M (2016) Social procurement in UK construction projects. *International Journal of Project Management*, **34**(2) 133-44.

McCrudden, C (2004) Using public procurement to achieve social outcomes. *Natural Resources Forum*, **28**(4) 257-67.

Oliver, C (1992) The antecedents of deinstitutionalization. *Organization Studies*, **13**(4), 563-88.

Ruparathna, R and Hewage, K (2015) Review of contemporary construction procurement practices. *Journal of Management in Engineering*, **31**(3).

Sporrong, J and Kadefors, A (2014) Municipal consultancy procurement: New roles and practices. *Building Research and Information*, **42**(5), 616-28.

Sutherland, V, McTier, A, Glass, A and McGregor, A (2015) *Analysis of the Impact and Value of Community Benefit Clauses in Procurement*, Glasgow. Training and Employment Research Unit (TERU). Glasgow: University of Glasgow.

Svensson, G (2015) Social Hänsyn I Offentlig Upphandling. Pilotprojekt Göteborgs Stad (Social Value in Public Procurement. Pilot Project The City Of Gothenburg). Gothenburg: The City of Gothenburg.

Sveriges Byggindustrier (2016a) Byggkonjunkturen: Fortsatt God Byggkonjunktur (The Building Economy: Continued Positive Economic Situation for Construction). Stockholm: Sveriges Byggindustrier.

Sveriges Byggindustrier (2016b) Ny Konjunkturbedömning Från Sveriges Byggindustrier: Bostadsbyggandet Mot Nya Höjder (New Economic Prognosis From Sveriges Byggindustrier: Residence Building Towards New Heights). [Available from https://www.sverigesbyggindustrier.se/ny-konjunkturbedomning-fran-sveriges-byg__6369].

Thornton, P H (2002) The rise of the corporation in a craft industry: Conflict and conformity in institutional logics. *Academy of Management Journal*. **45**(1), 81-101.

Thornton, P H and Ocasio, W (2008) Institutional logics. *In*: R Greenwood, C Oliver, R Suddaby and K Sahlin-Andersson (Eds.) *The Sage Handbook Of Organizational Institutionalism*. London: Sage Publications, 99-129.

Walker, K. and Brammer, S (2012) The relationship between sustainable procurement and e-procurement in the public sector. *International Journal of Production Economics*, **140**(1), 256-68.

Whyte, J and Sexton, M (2011) Motivations for innovation in the built environment: New directions for research. *Building Research and Information*, **39**(5), 473-82.

Wright, T (2015) New development: Can ‘social value’ requirements on public authorities be used in procurement to increase women's participation in the UK construction industry? *Public Money and Management*, **35**(2), 135-40.

Zuo, J, Jin, X-H and Flynn, L (2012) Social sustainability in construction: An explorative study. *International Journal of Construction Management*, **12**(2), 51-63.

Åkerlund, S. (2016) Historisk chans för många nyanlända (Historic chance for many refugees). *Byggindustrin*, June 1st.

DEMONSTRATING THE SOCIAL VALUE OF A SCHOOLS ENGAGEMENT PROGRAMME: INTRODUCING YOUNG PEOPLE TO THE CONSTRUCTION PROFESSIONS

Jemma Bridgeman[1], Peter Maple[2], Alex Murdock[3], Suzanne Hardy[4] and Christine Townley[5]

[1]*Construction Youth Trust, Ty Ffederasiwn, 66 Cardiff Road, Glan-Y-Llyn, Cardiff, CF15 7QE, UK*

[2&3] *London South Bank University, 103 Borough Road, London SE1 0AA, UK*

[4] *Network Rail Crossrail, Enterprise House, 167-169 Westbourne Terrace, London, W2 6JX, UK*

[5] *Construction Youth Trust, The Building Centre, 26 Store Street, London, WC1E 7BT, UK*

The research presents an impact study of Construction Youth Trust's and Network Rail's Budding Brunels Rail programme which aims to introduce young people facing barriers to careers within the construction professions. The aim was to develop complex and robust Social Return on Investment (SROI) measures which would work alongside more simplistic outcome-based binary measures preferred by government e.g. employed/unemployed. There are challenges developing a sufficiently robust SROI study particularly as there is not currently a theory of valuation of non-market goods to value outcomes in social science. Stakeholders were consulted to determine the changes that had happened for them as a result of the intervention and then a financial value was put on the changes. Both students and construction industry professionals consulted indicated they benefited from the programme. The research demonstrates while there are increasing arguments for the standardisation of SROI it would have not been possible to measure the impact of Budding Brunels without the flexibility of the approach.

Keywords: schools engagement, social return on investment, social value, SROI

INTRODUCTION

Construction Youth Trust's Budding Brunels programme is an Open College Network London (OCNL) accredited industry led, interactive, three day career advice and guidance workshop for students studying a Level 3 qualification. It challenges student's perceptions of what construction really means, whilst also introducing them to a variety of professional careers within the industry. A fundamental part of the Trust's mission is to encourage a more diverse construction industry that better reflect 21st century Britain. McCarthy *et al*., (2013, 40) explain "despite over 20 years of initiatives, research, and agendas the UK construction sector has failed to embed equality into business priorities and approaches; with both women and minority groups remaining under represented and unfairly treated in construction trades and the professions". The research focusses on developing an impact measurement framework

[1] jemma.bridgeman@cytrust.org.uk

Bridgeman, J, Maple, P, Murdock, A, Hardy, S and Townley, C (2016) Demonstrating the Social Value of a Schools Engagement Programme: Introducing Young People to the Construction Professions. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1007-1016.

for the schools engagement programme in the context of inequality and skills shortage within the industry means there is a need to recruit from a wider talent pool. The research aims to develop complex and robust SROI measures which would work alongside more simplistic outcome-based binary measures preferred by government e.g. employed/unemployed. This is a preliminary investigation to develop an SROI model to demonstrate the commercial, social and economic impacts of the Trust's Budding Brunels Rail programme. The suitability and scalability of the SROI framework will be examined in the context of a programme aiming to increase equality within the construction industry.

BUDDING BRUNELS RAIL

The Budding Brunels programme was cited as an example of good practice in the construction industry by the Equality and Human Rights Commission (EHRC, 2009, 43). In the EHRC report, Construction Youth Trust expressed concern that there is a real lack of understanding about the options available and commented that the negative image is based on a "stereotype that only encompasses craft/manual trades, outdoor work and a white male only culture". The lack of understanding means that 'even professional roles are not valued by potential graduates' (EHRC, 2009, 77). WISE (2015) note that their analysis reveals that construction is the most gender segregated industry in the UK as it is 12% female and 88% male. When construction apprenticeships are considered for 2013/2014 things do not show any sign of improving soon with just 130 females (2% of the total) undertaking apprenticeships in construction, planning and the built environment compared to 20.7% in ICT (WISE, 2015). Gale and Davidson (2009, 6) suggest the construction industry in the UK "perpetuates a predominant white, male able-bodied culture, which actively discriminates against change towards attracting a more socially inclusive, diverse workforce".

Construction Youth Trust worked with Network Rail to adapt the Budding Brunels workshop to develop Budding Brunels Rail. Budding Brunels Rail engages young people and communities along the Crossrail lines in East and West London. Network Rail and Construction Youth Trust wanted to capture the impact of the Budding Brunels Rail programme. Social Return on Investment (SROI) was selected as the framework to measure the programme. It was considered that SROI would set out clearly both the value to Network Rail and the community measuring key impacts and reporting on them in a way which was easy to understand. The research aimed to develop complex and robust SROI measures which would work alongside more simplistic outcome-based binary measures preferred by government e.g. employed/unemployed. It was examined how SROI could be used to demonstrate commercial, social and economic impacts of the Budding Brunels Rail programme.

The SROI Methodology: Solution or Challenge

Social Return on Investment (SROI) is a method for measuring a broader concept of value. It is a framework which measures social, environmental and economic costs and benefits. SROI is based on accountancy and cost benefit analysis and assigns a monetary value to social, economic and environmental returns to demonstrate wider value creation (Rotheroe and Richards, 2007). SROI measures the savings or returns created by the money spent on providing services. It is often monetised to show a ratio of savings as a result of the investment. For example an SROI study might find for every £1 invested in a project there was a return of £3 based on social, economic and environmental benefits this would result in a ratio of 3,1. However, SROI is more

than a financial ratio it attempts to capture financial, socio-economic and social returns through means of monetisation, quantification and qualitative description (Krlev *et al.*, 2013, 11).

The evidence suggests that the most contentious element of SROI is the monetisation of social outcomes (Arvidson *et al*., 2013, Gibbon and Dey, 2011, Krlev *et al*., 2013) Krlev *et al*., (2013) suggest the methodology of monetisation in SROI needs to be challenged critically suggesting the need for numbers drives analysts to extremely adventurous pathways when calculating the SROI ratio. The consequence of this can be a lack of rigour and objectivity in the process. The literature suggests a clear technical challenge is the lack of a theory of valuation underpinning the SROI methodology, particularly in the valuation of non-market goods to value outcomes, this can result in SROI studies being ad-hoc, inaccurate and out of date. Fujiwara (2015) notes outside economic theories of compensating surplus and equivalent surplus there is not an accepted theory of valuation of nonmarket goods and outcomes in social science. It has been argued that in terms of financial proxies there is an urgent need for standardised databases because there is currently a high degree of inaccuracy and ambiguity in the use and the description of financial proxies (Krlev *et al*., 2013, Fujiwara, 2015). Conversely, it is acknowledged because of the variety of interventions and organisations types developing universal tools and models is challenging (Krlev *et al*., 2013, Nicholls, 2009). Nicholls (2009, 758) asks how the rehabilitation of a drug user be quantitatively compared to reduced social exclusion due to increased employment.

An initial search of the literature revealed that transition to work initiatives tended to focus on young people at risk of becoming not in employment, education or training (NEET) (e.g. Coles *et al*., 2010 Dattani and Trussler 2011). Budding Brunels students face barriers but tend to be doing well in school so there were not proxies readily available to be used in an SROI study. For example, Dattani and Trussler (2011, 77) cite a financial benefit of £33,780 for each client that does not offend and they cite poor basic skills as one of the factors which can make offending more likely. There were examples of universities engaging with communities (Powis *et al*., 2007, IntoUniversity, 2010) but no construction examples were found. While there have been databases and universal tools developed in the case of Budding Brunels these were not useful to provide a framework for measurement (for examples see HACT and Fujiwara, 2014 and GVE, no date). There were also limited examples of SROI studies putting a value on equality for example see NEF (no date) but this study focused on a mental health day service therefore it was not useful in measuring a schools engagement programme. The SROI Network (2013) notes that in addition to stakeholder consultation there will often be research available to aid decision making.

Methodology

The guidance developed by the SROI Network (now Social Value UK) was followed to ensure transparency and consistency with existing practitioner SROI reports. The SROI Network suggests the SROI process is completed in six stages. The first stage involves setting the scope of the analysis and identifying key stakeholders. The second stage consists of mapping outcomes this is this is where a theory of change is developed this shows the relationship between inputs, outputs and outcomes. The third stage involves finding data to evidence that outcomes have happened and then putting a value on them. The fourth stage of the process involves establishing impact. This stage involves eliminating factors that would have happened anyway, if the

activity being analysed did not exist, from consideration. For example, if a youth employment initiative was being analysed and youth employment went up by 10% anyway this would need to be deducted, from any economic benefits claimed as a result of employment in order to establish impact. The fifth stage is calculating the SROI this stage involves dividing the net social, economic and environmental benefits from the amount invested in the activity. This stage is also where the sensitivity of the results can be tested. The sixth and final stage of the SROI process is reporting using and embedding (SROI Network, 2012).

To develop an SROI framework for Budding Brunels Rail a cohort of students were identified to help develop a bespoke methodology. The students attended a course in Acton in March 2014. In total there were eighteen students on the course six students were recruited from EHWL (Ealing, Hammersmith and West London) College and twelve students were recruited from Brentside High school. All eighteen students were Black, Asian and Minority Ethnic (BAME) and two of the students were also female (Bridgeman, 2015). The Trust already sought feedback from students following Budding Brunels courses from the following:

- Evaluation forms
- Progress Web: A tool the Trust's uses to capture students' progress towards a goal as a result of courses
- Student workbooks
- Pre and post work experience evaluation questions

Once existing sources of data had been analysed a telephone interview script and internet questionnaire were put together. In total eleven of the eighteen students representing 61% of students were surveyed to provide data for the SROI study. Three students, representing 16.6% completed an internet survey and eight students representing 44.4% participated in semi-structured telephone interviews.

A fundamental element of the SROI process is to involve stakeholders to examine if any changes have happened for them as a result of the activity being analysed. As part of the stakeholder consultation the construction industry were consulted and it was clear that industry valued the programme. An internet survey was launched to capture the skills construction industry volunteers developed as a result of participating in Budding Brunels. Fifteen construction industry professionals filled in an internet survey on their experience of volunteering on Budding Brunels the response rate was 50% for the survey. Not all the volunteers that filled in the survey had volunteered on the Acton course but they had all volunteered on a Budding Brunels course.

The Research Findings

Following the Budding Brunels Rail course students indicated an increase in confidence. Krlev *et al*., (2013, 8) note that it is extremely hard to capture soft outcomes including "'fluffy' variables like independence, self-esteem or subjective well-being". In SROI practitioner reports there has been a hesitancy to measure soft outcomes for example Dattani and Trussler (2011, 201) only focus on hard outcomes as softer outcomes such as the positive life effects of employment are subjective and difficult to quantify (Bridgeman *et al*., 2015). Wright *et al*., (2009) explain that some outcomes and impacts such as increased self-esteem cannot be easily monetised and therefore are often ignored. McNeil *et al*., (2012, 7) explain soft outcomes such as self-esteem and thinking skills underpin young people's progress but are hard to

measure. McNeil *et al*., (2012, 7) note it is often difficult to make the case for soft outcomes despite many compelling examples of "lives transformed, in which building these capabilities has been a pre-requisite for success in 'hard outcome' terms". It has been argued in the case of medical school admissions that initiatives to reduce socioeconomic inequality are not likely to be successful unless they recognise and tackle the close link between self-esteem, personal identity, and the specific aspects of working class culture that oppose traditional academic values and ambitions (Greenhalgh *et al*., 2004).

The only SROI or Cost Benefit Analysis (CBA) found for a similar intervention was the SROI of IntoUniversity (2010). Due to the lack of standardisation of the SROI methodology studies cannot currently be compared. It is frequently argued that that the SROI methodology is in urgent need of standardisation (Krlev *et al*., 2013, Arvidson *et al*., 2010). Conversely, SROI reports are a good source of data for practitioners and while the IntoUniversity (2010) SROI study was useful due to the lack of similar studies. Therefore, for the SROI of Budding Brunels stakeholders were consulted in order to identify what had changed for them as a result of taking part in Budding Brunels. The next stage of the analysis was a search of the literature to both support and put a value on the changes that stakeholders identified. Although there are inroads into the production of a standard approach to SROI the approach needs organisations to undertake a substantial amount of research to essentially put financial value on intangible measures. Fujiwara (2015) argues that difficulties interpreting the SROI ratio can be overcome by a set of clear and consistent guidelines for the practical application and interpretation of SROI. In the guide to SROI Nicholls *et al*., (2012, 7) suggest SROI is designed to achieve consistency as it is a set of principles that are applied within a framework. Conversely, suggesting there needs to be some flexibility within the as SROI should be stakeholder led the methodology needs to recognise value will be different for people in different circumstances and cultures (Nicholls *et al*., 2012). While, Mouchamps (2014) argues the SROI methodologies adaptability is one of its biggest strengths.

In a CITB (2014) survey, more than a quarter of employers (28%) that had experienced recruitment difficulties specified the need for personal skills, such as the right attitudes and motivations and common sense. The proxy for increased confidence was considered to encompass the soft skills young people develop or enhance as a result of taking part in Budding Brunels Rail. One student said the course "gave me more confidence in interviews and helped me see the different opportunities I have in the construction industry" another said "I gained confidence, experienced new things and got knowledge about Network Rail" (Bridgeman, 2015) The financial proxy used to value an increase in self-confidence was originally used in the SROI study of Veterans Contact Point (VCP) (Bates and Yentumi-Orofori, 2013).

Students told us the Budding Brunels Rail course "gave me confidence to do a course which was different to the one I first thought I would do"; "the course gave me the incentive to finish my qualification and go on to higher academic studies" and re-affirmed their desire to go to university. The evidence suggested that a financial proxy was needed as students indicated that Budding Brunels Rail had helped them get a more competitive university place. In its forecast SROI IntoUniversity (2010) used a financial proxy for a young person achieving a competitive university placement. They select the proxy of an in-depth UCAS drafting session at £100 and three hours of Gabbitas Education Consultancy at £210 per hour. While agreeing with this proxy in principal a proxy of £495 to draft a UCAS application consisting of five

one-to-one sessions with an expert in the field has been used to value young people gaining a competitive university placement as a result of taking part in Budding Brunels Rail.

The evidence suggests that students benefit from role models from the construction industry that volunteer on the programme. Hoare and Johnston (2014) suggest educational disadvantage can arise when a student's community provides a lack of local role models. Following budding Brunels Rail students are asked 'did you meet anyone whose job you can see yourself doing in the future? Students' comments included "yes, Becky she is in charge of the design team and ensures everything goes as planned" and "yes, I met Bob. Bob works on track he is responsible for the laying and maintaining on the track. In the future I would like to be doing this job" (Bridgeman, 2015). Greenhalgh *et al*., (2004) suggest that in order to be successful widening participation initiatives should make extensive use of role models from non-traditional backgrounds to mentor students.

The evidence also suggests that volunteers from the construction industry also benefit from the experience. When construction industry professionals were consulted about their volunteering experiences on Budding Brunels Rail they indicated they valued the experience. Feedback from speakers included "I enhanced some of my presentation skills and speaking to large groups of people. Also speaking in an educating role to people who were unsure of what I was taking about was a new experience as it was much different to what I was used to": "it improved my public speaking skills and "enhanced my teaching methods" (Bridgeman, 2015). Peterson (2004, 616) suggests that volunteer programmes are not just about enhancing corporate image they may also give employees the opportunity to develop new skills while avoiding the high costs of professional skill building courses. In the SROI practitioner report undertaken by IntoUniversity (2010) the cost of a training programme to increase confidence in working with young people to value the professional development of volunteers at £200.

Budding Brunels Rail helps young people to understand both careers within the construction industry and careers within Network Rail. The aim is that they will see Network Rail as an employer of choice or look at education options that would ensure they have the relevant experience and knowledge to join the industry. One of the aims of the Budding Brunels programme is to provide the industry with bright new talent to help overcome skills shortages within the construction professions. In 2013, the CITB commissioned the 2014 survey for 'Skills in the Construction Industry' (CITB, 2014). The essential themes of the survey were recruitment difficulties and skills shortages, skills deficiencies and gaps in established workforces and training and development activity in the construction industry across the UK as part of the CITB survey. Both quantitative and qualitative information was collected from the construction industry throughout the UK in the CITB survey. There was evidence that economic recovery was leading to a tightening of the labour market. Oxford Economics (2014) average estimate of £30,614 to cover recruitment costs and the cost of getting up to speed in a role was used to estimate the financial impact of hard to fill vacancies. The construction industry was not represented in the Oxford Economics report but a more suitable construction value was not found.

In its ideal application the only criterion for accountability in a commercial organisation is profitability (Schumacher, 1973, 205). Arguing that unless the number of criteria for accountability is kept small creativity and entrepreneurship cannot

flourish. This could lead to questions about the SROI of Budding Brunels Rail and available SROI databases (for examples see (HACT and Fujiwara, 2014) Social Value Bank and the Global Value Exchange (no date)) Firstly, does confining the currently flexible SROI methodology into a database mean that it is too narrow to capture social value? Secondly, is it valid to include the construction industry and construction industry professionals as stakeholders in the SROI analysis? Or on the basis of guidance from the SROI Network on materiality, a concept borrowed from accounting, if a piece of material information is missed out then the report is not transparent and misrepresents the organisations activities (Nicholls *et al*., 2012). Including the construction industry and construction industry professionals' financial benefit in the final SROI could make the financial ratio misleading as people could assume the financial benefit is only attributed to the beneficiaries. Nicholls (2009, 756) suggests "social impact reporting practices in social entrepreneurship attempt self-reflexively to enhance social mission". One of Construction Youth Trust's aims is to introduce the industry to bright new talent and arguably this means reducing skills shortages within the construction industry is a valuable part of this mission and it should be included in the SROI analysis.

Nevertheless, not including the benefit of reduced skills shortages in the construction industry and construction industry professionals gaining skills as a result of volunteering was considered as part of the sensitivity analysis of the SROI report. Part of calculating the SROI of a project involves testing the sensitivity of the results. The sensitivity analysis is where the overall impact of the proxies chosen for the analysis is tested. If there has been a decision made between two proxies these are tested in the sensitivity analysis. In the case of the SROI report of Budding Brunels Rail in Acton the SROI ratio was £1: £5.43 meaning for every £1 invested in the project there was considered to be wider social value of £5.43. However, if benefits for the construction industry and construction industry professionals are excluded from the study the SROI ratio is reduced by 34% to £3.58. On reflection a multi-stakeholder explanation might be more appropriate for the Trust's Budding Brunels programme using a multi-ratio approach where the financial benefits for industry and beneficiaries is reported separately and clearly explained.

It has been suggested measures that seek to standardise the calculation of SROI and the implications of such standardisation need to be investigated (Arvidson *et al*., 2010). The SROI model is structured but not standardised. The method has a focus on stakeholder consultation and analysis which maps inputs, outputs and impacts and the connections in between. While there are cogent arguments for a standardisation of proxies "to date there is rather a high degree of imprecision and ambiguity in the application and description of financial proxies" (Krlev *et al*., 2013, 5). However, in the case of the SROI of Budding Brunels proxies to value the programme were not found in standardised data bases. However, stakeholders of Budding Brunels did find the programme valuable including construction industry professionals. While a great deal of research is clearly needed in the development of SROI it will be interesting to see if increasing standardisation will lead to the loss of the flexibility of SROI that enables stakeholders to explain what is valuable to them.

CONCLUSIONS

The research presents an initial exploration of applying the SROI framework to Construction Youth Trust's and Network Rail's Budding Brunel Rail programme. The aim was to develop complex and robust measures which would work alongside

more simplistic outcome-based binary measures. The most contentious element of the SROI methodology is the monetisation of social outcomes. Putting a financial value on social outcomes was particularly difficult for Budding Brunels Rail as transition to work initiatives tend to focus on young people at risk of becoming NEET. After an initial literature review a cohort of students were selected to identify changes that had happened or them as a result of the programme. A value was put on helping students gain a more competitive university placement and increase in confidence.

However, stakeholder analysis also revealed that volunteers from the construction industry benefited from the programme and a cost of the equivalent professional development course was used to value this change. There were also considered benefits to the construction industry of decreased skills shortages as a result of encouraging young people to consider a career in construction. While it was possible to use the SROI framework and methodology to identify changes that stakeholders identified it was difficult. A significant amount or research was required to basically put a financial amount on intangible measures. Time consuming and difficult research to value the programme could have been overcome with more standardisation of the methodology. However, current databases such as HACT and Fujiwara, (2014) and GVE (no date) were not useful in this instance. A database that considered costs, savings and social value for the construction industry might have been useful. Conversely, it had been argued that the SROI methodologies flexibility is its greatest strength (Mouchamps, 2014, SROI Network, 2012). Equally, it would not have been possible to undertake a preliminary study to examine the value of Budding Brunels Rail without this flexibility. The SROI methodology clearly needs more research especially as there is not an accepted theory of valuation of non-market goods in social science.

REFERENCES

Arvidson, M, Lyon, F and McKay, S and Moro, D (2010) *The Ambitions And Challenges Of SROI*. Working Paper. Birmingham, UK: Third Sector Research Centre.

Arvidson, M Lyon, F McKay, S and Moro, D (2013) Valuing the social? The nature and controversies of measuring social return on investment. *Voluntary Sector Review*, **4**(1), 3-18.

Arvidson, M, Battye, F and Sailsbury, D (2014) The social return on investment in community befriending. *International Journal of Public Sector Management*, **27**(3), 225-240.

Bates, B and Yentumi-Orofori, R (2013) *Veterans Contact Point: Social Return on Investment SROI Report*.

Bridgeman, J (2015) *Budding Brunels Rail in Acton: Forecast SROI Report*. London: Construction Youth Trust.

Bridgeman, J, Murdock, A, Maple, P, Townley, C and Graham, J (2015) Putting a value on young people's journey into construction: Introducing SROI at Construction Youth Trust. *In*: A Raiden, A and E Aboagye-Nimo (Eds.) *Proceedings 31st Annual ARCOM Conference*, 7-9 September 2015, Lincoln, UK. Association of Researchers in Construction Management, 207-216.

CITB (2014). *Skills and Training in the Construction Industry 2014*. Birmingham: BMG Research, 3.

Coles, B, Godfrey, C, Keung, A, Parrott, S and Bradshaw, J (2010) *Estimating The Life-Time Cost Of NEET: 16-18 Year Olds Not In Education, Employment Or Training*, University of York, York.

Dattani, P and Trussler, S (2011) *Measuring the Social Impact of the Tomorrow's People Welfare to Work and Youth Programmes between 2006/07 and 2010/11*. London: FTI Consulting.

Equality and Human Rights Commission (2009) *Race Discrimination in the Construction Industry*. Manchester: Equality and Human Rights Commission, 43 and 77.

Fujiwara, D (2015) *The Seven Principle Problems of SROI*. London: SIMETRICA.

Gale, A G and Davidson, M J (2006) An introduction to diversity. *In*: A G Gale and M J Davidson (Eds.) *Managing Diversity and Equality in Construction: Initiatives and Practice*. London: Taylor and Francis.

Gibbon, J and Dey, C (2011) Development in Social Impact Measurement in the Third Sector: Scaling Up or Dumbing Down? *Social and Environmental Accountability Journal*, **31**(1), 63-72.

Global Value Exchange (no date) *Global Value Exchange*. Available from http://www.globalvaluexchange.org/ [Accessed 3rd April 2016]

Greenhalgh, T, Seyan, K and Boynton, P (2004) Not a university type: Focus group study of social class, ethnic, and sex differences in school pupils'. *British Medical Journal*, **328**:1541.

HACT and Fujiwara, D (2014) *Community Investment Values From The Social Value Bank*. Available from http://www.hact.org.uk/value-calculator [Accessed 3rd April 2014]

Hoare, A and Johnston, R (2011). Widening participation through admission policy: A British case study of school and university performance. *Studies in Higher Education*, **36**(1), 21-41.

IntoUniversity (2010) *IntoUniversity Social Return on Investment, December 2010*. London: IntoUniversity.

Krlev, G, Münscher, R and Mülbert, K (2013). *Social Return on Investment (SROI): State-of-the-Art Perspectives*. Heidelberg: Universtat Heidelberg.

McCarthy, C, Thomson, D and Dainty, A. (2013) Mainstreaming equality in construction: The case for organisational justice. *In*: S D Smith and D D Ahiaga-Dagbui (Eds.) *Proceedings 29th Annual ARCOM Conference*, 2-4 September 2013, Reading, UK. Association of Researchers in Construction Management, 273-282.

McNeil, B, Rich, J and Reeder, N (2012) *Framework of Outcomes for Young People. Department for Education*, The Young Foundation, London, UK.

Mouchamps, H (2014) Weighing elephants with kitchen scales: The relevance of traditional performance measurement tools for social enterprises. *International Journal of Productivity and Performance Management*, **63**(6), 727-745.

New Economics Foundation (Undated) *Equality Outcomes: Social Return on Investment Analysis. A report by the New Economics Foundation commissioned by the Equality and Human Rights Commission*. London: Equality and Human Rights Commission.

Nicholls, A (2009) 'We do good things don't we?' 'Blended Value Accounting' in social entrepreneurship. *Accounting, Organizations and Society*. **34**(6-7), 755-769.

Nicholls, J, Goodspeed, T, Lawlor, E and Neizert, E (2012) *A Guide to Social Return on Investment 2nd Edition*. London: SROI Network.

Oxford Economics (2014) *The Cost of The Brain Drain: The Financial Impact of Staff Turnover*. Oxford: Oxford Economics.

Peterson, D K (2004) Benefits of participation in corporate volunteer programs: Employees' perceptions. *Personnel Review*, **33**(6), 615-627.

Powis, D, Hamilton, J and McManus, L C (2007) Widening access by changing the criteria for selecting medical students. *Teaching and Teacher Education*, **8**(23), 1235-1245.

Rotheroe, N and Richards, A (2007) Social Return on Investment and social enterprise: Transparent accountability for sustainable development. *Social Enterprise Journal*, **3**(1), 31-48.

Wright, S, Nelson, D, Cooper, J M and Murphy, S (2009) An evaluation of the transport to employment (T2E) scheme in Highland Scotland using Social Return On Investment (SROI). *Journal of Transport Geography*, **17**(6), 457- 467.

STRATEGY AND INNOVATION

COLLABORATION BETWEEN HOUSEBUILDING FIRMS AND SUPPLIERS FOR THE IMPLEMENTATION OF INNOVATION STRATEGIES: A STRATEGY-AS-PRACTICE APPROACH

Giulia Leghissa[1], Daniel Sage[2] and Andrew Dainty[3]

[1&2] *School of Business and Economics, Loughborough University, Loughborough, Leicestershire, LE11 3TU, UK*

[3] *Civil and Building Engineering, Loughborough University, Ashby Road, Loughborough, Leicestershire LE11 3TU, UK*

Establishing long-term relationships, collaborating and making decisions with suppliers has become a major requisite for firms' competitiveness and for implementing innovation. In a relatively unbounded context, such as the construction industry, innovation takes place across a network of loosely coupled organisations. Thus, cooperation and efficient communication must transcend organisational boundaries in order for successful innovation to occur. This paper adopts a strategy-as-practice (S-A-P) approach to understand how innovation "strategizing" takes place between firms and suppliers and how power relations influence its implementation. This is used to examine how social practices, such as strategic meetings and workshops, bring about the coproduction of innovations between firms. The paper sets out a novel theoretical approach comprising targeted ethnographic observations and in-depth interviews. These are used as a framework for identifying how innovation takes place by analysing how collaborative innovation between the firms and their suppliers is executed, and in particular how power is distributed between and across those actors. It is argued that this approach offers a novel theoretical contribution towards understanding of how innovation takes place across inter-organisational boundaries and the collaborative mechanisms that might support it.

Keywords: collaboration, housebuilding, innovation, strategy-as-practice, power

INTRODUCTION

The construction sector is a large and complex area of the UK economy, contributing to £103 billion in economic output in 2014, and comprising a wide range of products, services and technologies (BIS 2013; Rhodes 2015). Innovation in the industry is not always profit-driven, but it is influenced by a panoply of "institutional contingencies", such as national policies, government regulations, construction standards, market and financial conditions and the public opinion for the environment (Dale 2007; Lizarralde *et al*., 2015). Hence firms need to find ways to adapt their procedures and technologies according to these external pressures. This process might not be easily implemented due to the high number of firms and actors involved in construction projects, and the low levels of innovation and flexibility to change.

[1] g.leghissa@lboro.ac.uk

Leghissa, G, Sage, D and Dainty, A (2016) Collaboration between Housebuilding Firms and Suppliers for the Implementation of Innovation Strategies: A Strategy-As-Practice Approach. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1019-1028.

Construction firms rarely innovate in isolation, but in collaboration with other firms, customers or suppliers, and in cooperation with innovation partners such as universities (Hauser 2010). This is a challenging as the sector is also characterised by high levels of sub-contracting, self-employment and a proliferation of many small and micro businesses (BIS 2013). As such, firms must harness the innovative capabilities of numerous actors and firms, many of which might be loosely coupled to the production effort. Such loose couplings could potentially foster novel solutions because of the involvement of many actors from different contexts, but at the same time may prevent innovation diffusion because of the structure of construction projects (e.g. difficulties in promoting learning, decentralisation, and short-term relationships). Hence loose couplings seem to favour short-term productivity and hamper innovation (Dubois and Gadde 2002). This complexity might go some way to explaining why the industry is often seen as slow to innovate (Goodier and Gibb 2007). Other reasons include client scepticism, a risk adverse culture, unproven durability of innovative solutions, uncertainty about demand, and the negative views of consumers (Jaillon and Poon 2008; Lovell and Smith 2010).

From this backdrop, it is clear that the construction industry represents a problematic arena for innovation. It is therefore necessary to develop a deeper understanding of how innovation may occur within the organisation and the supply chain. The focus here is on the housebuilding sector, which has long been regarded as one of the slowest areas of the industry to innovate (Winch, 1998; Ball 1999; Barlow 1999). Winch (1998), for example, has called for more case studies to be made around innovation in the sector, which is still characterised by low levels of innovation (Ozorhon *et al*., 2014). However relatively little research is being conducted in this area and thus new perspectives on the topics should be developed. In particular, there is a gap in literature concerning the distribution of power between actors during an innovation process. The aim of this paper is to understand how power is distributed between the firm and the suppliers throughout an innovation process. The focus of analysis would be on a micro-level of analysis by using an ethnographic and strategy-as-practice (S-A-P) approach during specific strategic episodes where innovation takes place. This is used to illuminate the ways in which strategies for innovation are formulated and what kind of role suppliers, who are outside the firm but still within the supply chain, have in such decisions.

By adopting a S-A-P perspective it is possible to focus on the actors' activities and behaviours in a particular setting, allowing the research to reveal more about the micro-dynamics of interaction that are often overlooked in accounts of innovation processes. The main purpose of this research is presenting a novel methodological approach by combining S-A-P and targeted ethnographies in different case studies of UK construction firms as a way of analysing the housebuilding sector and, in particular, to understand innovation in practice-based activities. Targeted ethnographies would help to focus on the different specialist groups which are usually involved in construction projects (Tutt, Pink, Dainty, and Gibb 2013) and would also represent a novel approach to understand how actors' interactions and practices occur during an innovation process. The paper also aims to outline previous relevant research in the construction sector focusing on collaborative innovation and power relationships, to explore the potential of S-A-P theory to reveal the ways in which power shapes innovation outcomes within the sector and to build upon this to develop a research approach to studying innovation practices at this level.

Construction Innovation

Why more innovation research is needed in construction

Implementing innovation is undoubtedly a means to improve performance, but it is also challenging due to the fragmentation of the construction industry. Most research on the innovation process has focused on the firm level, whereas the project-level has been little considered. This is because of the difficulties of following and controlling all the activities executed by the actors involved in construction projects (Dulaimi *et al*., 2002; Blayse and Manley 2004). Nonetheless, the construction (and housebuilding) industry relies heavily on co-developing innovation with the other participants in the projects (e.g. designers, sub-contractors, clients, suppliers) and mainly innovates at the project level (NESTA 2007). Moreover, there is a lack of research concerning inter-organisational innovation which also emphases the importance of network relationships. The case study by Ozorhon *et al*., (2014) emphasises the importance of integration between project participants to facilitate knowledge sharing and the adoption of innovation. For example, the establishment of partnering agreements with suppliers enables the innovation to flow. Given this, the next section will address the importance of inter-organisational activities, such as collaboration within the supply chain.

Collaboration and networks

Within the construction industry, success comes from effective inter-organisational management and collaboration. An extensive literature emphasises how innovations success is created by investing and sharing resources, knowledge, and risks, and developing open communication with suppliers. Sharing knowledge is traditionally seen as a source of power in the supply chain and it therefore needs trust to be shared and, by doing so, innovation is built through a learning process (Soosay *et al*., 2008; Frankel *et al*., 2002). Within the built environment, issues on innovation adoption and diffusion involve the presence of different actors and interests. For example, science and technology studies (STS) have highlighted the role of networks, actors and the concept of "unbounded innovation", whereas institutional scholars have shifted the focus on "collective action" (Whyte and Sexton 2011). In particular, the role of networks has been developed in construction literature, such as through Winch's (1998) model of innovation diffusion which depicts the importance of the "superstructure" (clients, and professional institutions) in encouraging the diffusion of innovation by putting pressure on the supply chain partners. Larsen (2015), through a social network analysis (SNA), also emphasises the importance of actors in diffusing innovation within an "outward-looking network". The presence of many actors within a project raises questions on how power is distributed and used.

The role of power

The involvement of many actors within a single project raises the issue of power relations. This has been acknowledged in literature concerning buyer-seller relationship and power-dependency. The first author to discuss about the importance this relationship was Porter (1980) in his five force model. More recent studies argue that power comes from a combination of interrelated factors: who holds power is influenced by the organisational context, individual characteristics of buyers and sellers, and relational interactions (Meehan and Wright 2012). Cox argues that only businesses in possess of value and power over the other actors (e.g. customers, suppliers, competitors) are successful and therefore conflicts of interests arise in vertical participants in the supply chains. He thus affirms the importance of practitioners knowing the power structures in their supply chains in order to

understand how to strategically manage them. This perspective clashes with the lean thinking approach which emphasises the importance of integrated supply chains and power interdependence (Cox 1999). This asymmetric power/dependence relationship emphasised by Cox is however largely associated with unproductive relationships in literature, even though an asymmetrical distribution of power in reality seems inevitable due to the different characteristics of the firm and suppliers (Caniëls and Gelderman 2007; Nyaga *et al*., 2013). Analysing the role of power becomes important when innovation has to be adopted, because it enables researchers to understand how collaborative activities and decisions are made. Moreover, assessing whether suppliers have enough power to make strategic decisions may open new innovative initiatives for the firm, or lead to conflicts.

Theories on strategy-as-practice and the role of power and discourse

Within S-A-P literature, the interest in strategy as discourse has recently increased, but its role in relation to power remains underdeveloped (Hardy and Thomas 2014). Foucault (1980) discusses the conceptualisation of power and discourse, in which power circulates and it is not centralised, but it is "deployed and exercised through a net-like organization", in which power relations pervade all levels of social existence. He also argues that power is "productive" and thus creates knowledge and discourse. Knights and Morgan (1990) also recognise a relation between discourse and power and argue that “the discourse and practice of strategy is distinctively a mechanism of power”. Finally, Foucault does not focus on the general strategies of power, but focuses on the "micro-physics of power", which look at the localised mechanism of power circulation. Hardy and Thomas (2014), drawing on Foucault's theory, found that discourse shapes strategy in ways that are not dependent only on the senior managers, but also on multiple local practices over which senior strategists have little control. This also indicates that one discursive element of strategy can be weakened through resistance, while another can be strengthened. Such findings highlight the importance power in shaping praxis and knowledge as a way to develop innovation strategies within a group of actors.

The origins of S-A-P literature can be traced to the study of strategy in various organisational contexts, which began to establish a stable identity at the beginning of 2000s (Vaara and Whittington 2012). There are economic, theoretical and empirical factors which explain the diffusion of this perspective. First of all, the increasing pace of change of the economic environment has led to a shift of strategy making from a well-defined and stable system of decision making into a more continuous process (Eisenhardt and Brown 1999) based on everyday practices and involving many members inside an organisation. Secondly, at the theoretical level, the resource-based view (RBV) failed to empirically consider types of activities, and micro-activities, such as managerial activities, and their contribution to gain competitive advantage. As S-A-P is more focused on actors and praxis, it could give more emphasis to these activities than a RBV perspective on strategy. Moreover, other theories, such as dynamic capabilities drawing on evolutionary theory, and institutional theory also failed to highlight, respectively, the roots of dynamic capabilities, and the nature of negotiations among actors to create and change institutions (Gavetti 2005; Johnson *et al*., 2007). Thirdly, empirical research on corporate structure relies too much on large-scale cross-sectional studies. Since structures are in continuous flux, it is necessary to have a better understanding of the activities involved in creating and implementing them (Johnson *et al*., 2007).

S-A-P scholars argue that strategy is something that "people do", rather than something that "organisations have" (Jarzabkowski *et al*., 2007). Strategy is thereby analysed as it evolves and as it is made by individuals. This perspective can have various benefits: it is possible to assess how strategies are shaped by different actors, and it helps to get insights into macro- and micro-level concerns in the strategic field. This "activity-based view" of micro-phenomena has to be understood in its social context: S-A-P concerns "what people do in relation to strategy and how it is influenced by and influences their organizational and institutional context" (Johnson *et al*., 2007; Jarzabkowski *et al*., 2007). The S-A-P approach is characterised by plurality of actors (called "practitioners") who are always reliant on the wider context of institutionalised and organisational practices. These kinds of practices include, for example, strategic planning, tools and techniques for strategic analysis, agenda-driven behaviour in meetings or boards, etc. Beyond those practices people engage with, practices can also relate to what people actually do for strategizing. These last practices can be referred to as "praxis", which is the "concrete, unfolding activity as it takes place" and it is guided by practices (Whittington 2006). For all these reasons, S-A-P, and also theories of power assume a key role in analysing the interplays between external actors' praxis (e.g. suppliers) and internal actors' praxis (e.g. the housebuilding firm) in constructing, for example, an innovation strategy workshop.

S-A-P scholars can use a wide range of theoretical perspectives which comprise of different strands of practice theory (Suddaby *et al*., 2013). In S-A-P literature there has been an increasing number of researches focusing on the linguistic nature of strategizing and the ways in which language shapes strategy. S-A-P has been linked to studies which examine different forms of interactions and discourse. It highlights that strategists make use of discourse through narrative, rhetoric, and metaphor, or through discursive activities such as justifying, legitimating and naturalising (Vaara and Tienari 2002; Hardy and Thomas 2014). S-A-P research should be supported both by traditional research methods (e.g. structured interviews and questionnaires), both by documentary analysis with ethnographic observation (Rasche and Chia 2009). The next section will try to understand how all the themes discussed in this section can be analysed and applied to this specific research.

Discussion: Towards a method for understanding the micro-dynamics of interaction underpinning inter-firm innovation strategy

Winch's (1998) model of innovation highlights the mediation role of the system integrator (e.g. a contractor) who can guide and manage the implementation process of a specific innovation. According to the concept of relative boundedness (Harty 2008), it may happen that innovation's effects lie within the control of such implementer (relatively bounded), or it may extend beyond such sphere of influence (unbounded). The second scenario is what usually happens in a construction project where numerous firms and actors work together. In this context, the characteristics of an innovation are transformed and shaped in practice by different actors who are likely to have different requirements. It is therefore difficult but essential to build efficient collaboration and communication which should travel across organisational boundaries (Harty 2005; Harty 2008). In this context, issues of power relations again pervade inter-organisational activities, such as specific "strategic episodes".

Within the S-A-P literature, the concept of "strategic episodes" has been developed as a framework to analyse meetings. The term episodes refer to the characteristic of events of being formed by a beginning and a pre-defined end which becomes the

reference point for all the other activities within the meetings. Beginning and ending thus refers to two points of temporary structural change (Hendry and Seidl 2003). Some authors argue that strategic episodes are more or less ritualised. Participants distance themselves from daily activities and engage, temporarily, in this privileged environment where a sort of "liturgy" is carried out and a collective engagement and emotional commitment is created. Strategy workshops are usually useful to motivate and emphasise the understanding of the strategy. However, they need to be followed by an implementation plan and good communication throughout the organisation in order to obtain tangible outcomes (Johnson *et al*., 2010). The observation and analysis of meetings and workshops allows researchers to understand the real day-to-day challenges of interaction between different actors. Indeed relationship dynamics may appear different in these settings than they are depicted by the firm's managers.

The reason to adopt an S-A-P perspective to analyse those episodes lies in the fact that, being a practice-based approach, it emphasises the daily routines within a project and gives importance to the strategy discourse as a way of creating knowledge such that power relations can be analysed by looking at language and activities. These micro-practices may represent the response of actors to an innovation and may characterise collaborative activities towards strategic decisions. According to co-production research which emphasises the importance of engaging industry and research, Green and Harty (2008) found that there are some areas which are considered central in the industrial context, such as the need for better collaboration across the supply chain, particularly when considering innovation. Such affirmation lies in the fact that the networks within a supply chain are sources of innovation and knowledge.

Proposed research approach

The proposed methodology for this research is based on case studies of large-medium housebuilding firms in the UK. In order to understand how those firms and suppliers collaborate and implement innovations, it is also important to examine the types of interactions and the role of suppliers in shaping the firm's strategy for innovation. It is proposed to use a qualitative research design comprising participant and non-participant observations, interviews, informal conversations with actors on the field of study, audio- and video-recording, and taking photos. The use of targeted ethnographies represents a method of data collection which requires short periods of fieldwork (e.g. weeks or months), even though it is a "data intensive" process (Knoblauch 2005:16) in which a lot of different techniques should be used. In particular, the support of audio- and video-recording of activities helps to extend the ethnography beyond the actual encounter (Pink and Morgan 2013). It is thereby possible to collect and analyse lots of data without being present for long periods on field.

The process of collecting data will take place during specific strategic episodes, such as formal meetings between the firm and its suppliers and workshops. Participation during meetings will mostly comprise of observing the normal execution of the meetings with a particular attention to the types of interactions and activities and the type of language and discourse used to shape innovation strategies. Targeted ethnographies during workshops or training days can be useful to observe how suppliers and the firm may react to an innovation (e.g. a new technology or a new building process). Workshops with suppliers would probably give the chance for suppliers of being presented with potential innovation strategies involving the supply chain. However, they may also be able to discuss with the firm about new products

(e.g. materials, technologies) to be adopted by the organisation and thereby influence future strategic decisions. The point to consider and try to understand is whether suppliers really have such power to influence the firm's strategy concerning innovation. Moreover, these observed activities and interactions may differ from the interviews with the firm and suppliers, and may give a more detailed and real representation of suppliers-firm relationship. Being an external observer may also represent an opportunity to interpret actors' praxis and organisations' practices in a different and novel way compared to the actors directly involved. In this sense, even collaborative innovation and power asymmetries may be observed through this approach. For example, the process of making decisions on technical aspects of the project may become a learning process for both of the actors and lead to the development of innovative strategies. Nonetheless, in-depth interviews would still be important as a framework to understand how the firm is organised and how the relationships with the suppliers are managed, and to obtain a subjective and deeper perspective of the members in terms of their opinions concerning supply chain relationships, organisational culture, and approach to innovation.

Looking at the distribution of power in making day-to-day strategic and technical decisions, the specific duties, the behaviour and interactions in particular settings would lead to the development of a framework to research innovation strategizing. Indeed the project tries to explain that innovation strategies are the result of micro-dynamics of different actors throughout different strategic episodes (e.g. meetings and workshops). An ethnographic approach is therefore the most appropriate method of data collection, since it allows to be present where action occurs and strategies are discussed. Indeed, in a study by Hartmann, ethnography, which includes observations and informal talks, served as a way to reveal micro-cultural aspects which were embedded in everyday practices within the project team. Such approach enabled the researcher to understand collaborative relationships between two construction parties as a process of learning which involved the project team and the researcher (Hartmann 2013). In such an illusory "win-win" situation, power asymmetries may play an important role in shifting the innovation process from one actor to another (e.g. from the firm to the suppliers). Such approach, which applies S-A-P and power theory, may offer contributions both to construction innovation and S-A-P literature itself.

CONCLUSIONS

The aim of this paper is to understand how power influence suppliers-firm interactions when implementing innovation strategies. Using S-A-P approach will shift the research focus on the micro-activities during formal meeting and workshops, key arenas where collaborative inter-firm innovation takes place. Moreover, the combination of this approach with targeted ethnographies in specific settings will provide a fresh perspective on how collaborative innovation is developed and implemented through collaborative praxis. The research will respond to gaps in literature concerning power through an S-A-P lens, and innovation in housebuilding through a focus on micro-dynamics and ethnography. The results of the research will shed light on the collaborative relationships and activities within the supply chain, and will explain how power is distributed and innovation strategy is managed in contexts, where different actors' perspectives are present. In particular, understanding power will help to highlight the role of suppliers in communicating with the firm and in responding to innovation. It is hoped that such approach might help to shed new light on inter-firm innovation strategies within the UK housebuilding sector.

REFERENCES

Ball, M (1999) Chasing a snail: Innovation and housebuilding firms' strategies. *Housing Studies*, **14**(1), 9-22.

Barlow, J (1999) From craft production to mass customisation: Innovation requirements for the UK housebuilding industry. *Housing Studies*, **14**(1), 23-42.

BIS (2013) *UK Construction: An Economic Analysis of the Sector*. Department of Business Innovation and Skills.

Blayse, A M, and Manley, K (2004) Key influences on construction innovation. *Construction Innovation*, **4**(3), 143-154.

Caniëls, M C J and Gelderman C J (2007) Power and interdependence in buyer supplier relationships: A purchasing portfolio approach. *Industrial Marketing Management*, **36**(2), 219-229.

Cox, A (1999) Power, value and supply chain management. *Supply Chain Management: An International Journal*, **4**(4), 167-175.

Dale, J (2007) *Innovation In Construction: Ideas Are The Currency Of The Future*. CIOB.

Dubois, A and Gadde, L (2002) The construction industry as a loosely coupled system: Implications for productivity and innovation. *Construction Management and Economics*, **20**, 621-631.

Dulaimi, M F, Ling, F Y Y, Ofori, G and DeSilva, N (2002) Enhancing integration and innovation in construction. *Building Research* and *Information*, **30**(4), 237-247.

Eisenhardt, K M and Brown, S L (1999) Patching: restitching business portfolios in dynamic markets. *Harvard Business Review*, **77**(3), 72-83.

Foucault, M (1980) *Power/Knowledge: Selected Interviews and Other Writings 1972-1977*. Brighton: Harvester Press.

Frankel, R, Goldsby, T J and Whipple, J M (2002) Grocery industry collaboration in the wake of ECR. *International Journal of Logistics Management*, **13**(1), 57-72.

Gambatese, J A and Hallowell, M (2011) Enabling and measuring innovation in the construction industry. Construction Management and Economics, 29(6), 553-567.

Gavetti, G (2005) Cognition and hierarchy: Rethinking the microfoundations of capabilities' development. *Organization Science*, **16**(6), 599-617.

Goodier, C I and Gibb, A G F (2007) Future opportunities for offsite in the UK. *Construction Management and Economics*, **25**(6), 585-595.

Green, S D and Harty, C (2008) Towards a co-production research agenda for construction competitiveness. *In*: *Joint 2008 CIB W065/W055 International Symposium*, Dubai.

Hardy, C and Thomas, R (2014) Strategy, discourse and practice: The intensification of power. *Journal of Management Studies*, **51**(2), 320-348.

Hartman, A (2013) Contribution of ethnographic practice to community-engaged research in construction management. *In*: S Pink, D Tutt and A Dainty (Eds.) *Ethnographic Research in the Construction Industry*. London and New York: Routledge.

Harty, C (2008) Implementing innovation in construction: Contexts, relative boundedness and actor-network theory. *Construction Management and Economics*, **26**(10), 1029-1041.

Harty, C (2005) Innovation in construction: A sociology of technology approach. *Building Research* and *Information*, **33**(6), 512-522.

Hauser, H (2010) *The Current And Future Role Of Technology And Innovation Centres In The UK*. Department of Business Innovation and Skills.

Hendry, J and Seidl, D (2003) The Structure and significance of strategic episodes: Social systems theory and the routine practices of strategic change. *Journal of Management Studies*, **40**(1), 175-196.

Jaillon, L and Poon, C S (2008) Sustainable construction aspects of using prefabrication in dense urban environment: A Hong Kong case study. *Construction Management and Economics*, **26**(9), 953-966.

Jarzabkowski, P, Balogun, J and Seidl, D (2007) Strategizing: The challenges of a practice perspective. *Human Relations*, **60**(1), 5-27.

Johnson, G, Prashantham, S, Floyd, S W and Bourque, N (2010) Ritualization of strategy workshops. *Organization Studies*, **31**(12), 1589-1618.

Johnson, G, Langley, A, Melin, L and Whittington, R (2007) *Strategy As Practice: Research Directions And Resources*. New York: Cambridge University Press.

Knights, D and Morgan, G (1990) The concept of strategy in sociology: A note of dissent. *Sociology*, **24**(3), 475-483.

Knoblauch, H (2005), Focused ethnography. Forum: Qualitative Social Research/ Sozialforschung, **6**(3), Article.44, 16.

Larsen, G D (2015) Innovation diffusion across firms. *In*: F Orstavik, A Dainty and C Abbotte (Eds.) *Construction Innovation*. Chichester, West Sussex: Wiley-Blackwell.

Lizarralde, G, Bourgault, M, Drouin, N and Viel, L (2015) Stakeholder integration champions and innovation in the built environment. *In*: F Orstavik, A Dainty and C Abbotte (Eds.) *Construction Innovation*. Chichester, West Sussex: Wiley-Blackwell.

Lovell, H and Smith, S J (2010) Agencement in housing markets: The case of the UK construction industry. *Geoforum*, **41**(3), 457-468.

Meehan, J and Wright G H (2012) The origins of power in buyer-seller relationships. *Industrial Marketing Management*, **41**(4), 669-679.

National Endowment for Science, Technology and the Arts (2007), *Hidden Innovation*. London.

Nyaga, G N, Lynch D F, Marshall D and Ambrose E (2013) Power asymmetry, adaptation and collaboration in dyadic relationships involving a powerful partner. *Journal of Supply Chain Management*, **49**(3), 42-65.

Ozorhon, B, Abbott, C and Aouad, G (2014), Integration and leadership as enablers of innovation in construction: Case study. *Journal of Management in Engineering*, **30**(2), 256-263.

Pettigrew, A M (1997) What is a processual analysis? *Scandinavian Journal of Management*, **13**(4), 337-348.

Pink, S and Morgan, J (2013), Short-term ethnography: Intense routes to knowing, *Symbolic Interaction*, **36**(3), 351-361.

Porter, M (1980) *Competitive Strategy*. New York: Free Press.

Rasche, A and Chia, R (2009) Researching strategy practices: A genealogical social theory perspective. *Organization Studies*, **30**(7), 713-734.

Rhodes, C (2015) *Construction Industry: Statistics and Policy*. House of Commons Library.

Samra-Fredericks, D (2003) Strategizing as lived experience and strategists' everyday efforts to shape strategic direction. *Journal of Management Studies*, **40**(1), 141-174.

Soosay, C A, Hyland, P W and Ferrer, M (2008) Supply chain collaboration: Capabilities for continuous innovation. *Supply Chain Management: An International Journal*, **13**(2), 160-169.

Suddaby, R, Seidl, D and Lê, J K (2013) Strategy-as-practice meets neo-institutional theory. *Strategic Organization*, **11**(3), 329-344.

Tutt, D, Pink, S, Dainty, A, and Gibb, A (2013) We've got our own language: The communication practices of migrant workers in the UK construction industry. In: Pink, D, Tutt, D and Dainty, A (Eds.) *Ethnographic Research in the Construction Industry*. London and New York: Routledge.

Vaara, E and Whittington, R (2012) Strategy-as-Practice: Taking social practices seriously. *The Academy of Management Annals*, **6**(1), 285-336.

Vaara, E and Tienari, J (2002) Justification, legitimization and naturalization of mergers and acquisitions: A critical discourse analysis of media texts. *Organization*, **9**(2), 275-303.

Whittington, R (2006) Completing the practice turn in strategy. *Organization Studies*, **27**(5), 613-634.

Whyte, J and Sexton, M (2011) Motivation for innovation in the built environment: New direction for research. *Building Research* and *Information*, **39**(5), 473-482.

Winch, G (1998) Zephyrs of creative destruction: Understanding the management of innovation in construction. *Building Research* and *Information*, **26**(4), 268-279.

ABSORPTIVE CAPACITY AS A BASIS FOR CONSTRUCTION INNOVATION: FROM A CAPABILITIES TO A ROUTINES PERSPECTIVE

Kate Lawrence[1], Paul W Chan and Andrew James

[1] *School of Mechanical, Aerospace and Civil Engineering, Pariser Building, Sackville Street, Manchester, M13 9PL, UK*

[2] *Manchester Institute of Innovation and Research, Alliance Manchester Business School, Booth Street West, Manchester, M15 6PB, UK*

Construction has been described as a sector with weak levels of Absorptive Capacity. At a time when the performance of the UK construction sector, in terms of levels of exports and future financial sustainability, is being widely discussed by policy makers, are the actual levels of Absorptive Capacity a 'real and present' risk to future sector performance? High levels of Absorptive Capacity have been positively linked with innovation success and organisational performance, including financial growth and increased productivity levels. The dynamic nature of Absorptive Capacity, rooted in the routines of individuals or organisations, ultimately strengthen an organisations capability to discover and benefit from new knowledge and novel technologies. For a UK construction sector (which is regularly impacted by turbulent external environments), ensuring that at individual, firm and sector level, dynamic capabilities are not allowed to 'stagnate', is of uppermost importance. Since, stagnation can result in low levels of Absorptive Capacity (Pentland *et al*., 2012). Therefore, rather than examining Absorptive Capacity from a relatively static capabilities viewpoint and by drawing on the contemporary scholarship of Absorptive Capacity Routines, are there opportunities to evaluate the impact of Absorptive Capacity levels across the diverse and complex sector? And beyond the life of project?

Keywords: Absorptive Capacity, Absorptive Capacity Routines, dynamic capabilities, microfoundations

INTRODUCTION

The Absorptive Capacity of a firm plays a crucial role in determining the firm's innovation performance (e.g. Foss *et al*., 2010, and; Allas, 2014). Absorptive Capacity, as Allas (2014) explained, is the ability of a firm to recognise the value of, assimilate and commercially exploit new, external information and is a strong indicator of a firm's ability to innovate. This capacity is "a function of the relationship between capabilities, structures, routines and policies particular to a firm" (Allas, 2014, 12). Indeed, Absorptive Capacity, first coined by Cohen and Levinthal (1990), has stimulated a number of studies to unpack innovation performance in the construction context (e.g. Gann, 2001; Blayse and Manley, 2004; and Reichstein *et al*., 2005). In these studies, the accepted wisdom is that the construction industry's innovation performance is hampered by its relatively weak Absorptive Capacity when

[1] kate.lawrence-2@postgrad.manchester.ac.uk

Lawrence, K, Chan, P W and James, A (2016) Absorptive Capacity as a Basis for Construction Innovation: From a Capabilities to a Routines Perspective. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1029-1038.

compared with other industries (see Gann, 2001; Winch, 2003; Blayse and Manley, 2004; Reichstein *et al*., 2005; Allas, 2014).

Prevailing scholarship, on explaining the impacts of Absorptive Capacity on innovation in construction, have often focussed on the structural conditions of how input measures of firm's ability to engage in learning new external knowledge, can impact on output measures, through such proxies as the number of patents and R&D investment. Yet, as a growing line of scholars (e.g. Reichstein *et al*., 2008; Flatten *et al*., 2011; Jiménez-Barrionuevo *et al*., 2011; and Bygballe and Ingemansson, 2014) argue, such measures often do not fully account for the multidimensional complexities of Absorptive Capacity, or the innovativeness of complex and multidisciplinary sectors such as construction. The purpose of this conceptual paper is, therefore, to go beyond these structural accounts of how Absorptive Capacity can influence innovation performance, to raise the question as to how we might better understand the dynamics of the impacts of Absorptive Capacity. The construction sector has often been characterised as project-based, configured through temporary coalitions of different professional and occupational groups (see Winch, 1998). As a consequence, the transient nature of construction work has often been blamed for the industry's relative weakness is absorbing new, external knowledge, which in turn stymies the industry's ability to innovate.

Our point of departure with this dominant view, is motivated by the possibilities found in the literature that proposes a countervailing view that the construction industry has the capacity to learn from project to project. For instance, the (London 2012) Olympic Delivery Authority's (ODAs) programme-wide approach to systems delivery was informed by lessons learned from the BAA Heathrow T5 project 'construction to operation' transition process (Davies *et al*., 2009; Brady and Davies, 2014). Lessons learnt from Heathrow T5 and London 2012 have also been exploited in the subsequent Crossrail programme (Davies *et al*., 2014). Thus, we argue in this paper for the need to move beyond 'headline' measures such as the number of patents registered, or the number of R&D Staff employed etc., to reflect more thoroughly on the dynamics of Absorptive Capacity and how these can serve to improve the sector's innovation performance. Moreover, simply measuring Absorptive Capacity capabilities through these static proxy measures would prevent us from capturing broader tacit and 'intangible resources' associated with Absorptive Capacity (Flatten *et al*., 2011).

In this paper, we draw inspiration from contemporary scholarship of organisational routines (see e.g. Parmigiani and Howard-Grenville, 2011) to open up questions as to how we might move away from examining Absorptive Capacity from a relatively static capabilities viewpoint, to one that acknowledges the dynamics of Absorptive Capacity practices and routines. This paper is structured as follows, initially we discuss Absorptive Capacity and Absorptive Capacity Routines. We then reflect on contemporary arguments in relations to routines and microfoundations and academic literature to date on Absorptive Capacity Routines within a construction context. We then suggest further areas of research, which would extend our understanding of the dynamics of the impacts of Absorptive Capacity, citing examples from practice. We conclude by considering how acknowledging the dynamics of Absorptive Capacity practices and routines provides opportunities for the construction sector to openly promote accurate levels of Absorptive Capacity, not just across the diverse and complex sector, but also, beyond the bounds of a project.

Absorptive Capacity and Absorptive Capacity Routines

To better understand the levels of Absorptive Capacity within the UK construction sector, we commence with Zahra and George (2002) reconceptualization of the Absorptive Capacity concept into its constituent routines and processes. In their reconceptualization of Cohen and Levinthal's Absorptive Capacity concept, Zahra and George (2002) described Absorptive Capacity in terms of a "dynamic capability embedded in a firm's routines and processes" (2002, 186). The concept of Dynamic Capability had been defined by Teece *et al*., (1997) as an ability which allowed a firm to adapt to changing environments through the integration and reshaping of both internal and external routines. When reviewing how organisations were able to develop dynamic capabilities, Zollo and Winter (2002) recognised that whilst Teece *et al*., (1997) had suggested what dynamic capabilities were for and how they might work, there were unanswered questions in relation to their genesis. Hence, Zollo and Winter (2002) proposed that dynamic capabilities were created through the continued interaction and mutual adjustment of 'learning mechanisms' (i.e. experience accumulation, knowledge articulation and codification) and developed a definition for Dynamic Capabilities which described the systematic creation and transformation of operating routines. The fluidity of the 'from' – 'to' nature of dynamic capabilities was also addressed in Zahra and George's (2002) model of Absorptive Capacity in terms of 'potential' (knowledge acquisition and assimilation) and 'realised' (knowledge transformation and exploitation) capabilities. Todorova and Durisin (2007) further refined Zahra and George (2002) reconceptualization through the introduction of a feedback loop to capture the dynamic aspects of the model.

Foss *et al*., (2010) highlighted the need for research on feedback loops as a gap in previous empirical studies of Absorptive Capacity and also argued that "discussing Absorptive Capacity merely as a capacity without discussing the actual processes that link it to outcomes variables such as patents, innovation and performance cannot be regarded as an integrated approach" (2010, 939). Foss *et al*., (2010) subsequently developed an integrative Absorptive Capacity framework which considered the moderating effect of environmental conditions on the relationships between the microfoundations of Absorptive Capacity (including managerial/intra/inter-organisational antecedents and prior knowledge); its process dimension (acquisition, assimilation, transformation and exploitation) and tangible (for example, innovation, R&D and firm performance) and intangible (for example, intra-organisation transfer of knowledge, knowledge search and inter-organisational learning) outcomes.

The construct of Absorptive Capacity was further operationalised through Lewin *et al*.'s (2011) "Internal and External Absorptive Capacity Metaroutines" framework, which expressed meta (higher order) Absorptive Capacity Routines (such as codified or tacit norms, standards, habits and rules, formed through formal reflection, trial and error and past experience) which were "firm specific, idiosyncratic and observable" (2011, 85). Lewin *et al*.'s (2011) framework split the Absorptive Capacity Metaroutines in to internal routines (associated with variation, selection and replication processes) and external routines (which facilitated external search and exploration to inform organisations innovation processes).

Absorptive Capacity Routines and Microfoundations in Construction

Hence, Cohen and Levinthal's (1990) Absorptive Capacity concept has been reconceptualised as a dynamic capability that is open to continuous change and able to move back and forth between knowledge source and competitive advantage and which

can be operationalised through observable routines and microfoundations. In the context of construction, academic discourse on Absorptive Capacity Routines is limited - is this because Absorptive Capacity Routine research in respect of construction is still in its infancy, or due to uncertainty within the research field surrounding the current academic debates over the perceived relevance of microfoundations or the definition of routines?

In terms of the debate on the definition of "routines", Feldman's (2000) contemporary view on routines as effortful accomplishments, rather than as mundane and static building blocks (Zollo and Winter, 2002), consider routines as a great source of creativity and continuous change (e.g. Feldman, 2000; Parmigiani and Howard-Grenville, 2011, and; Dionysiou and Tsoukas, 2013). Feldman and Pentland (2003) further argued that routines were able to generate multiple outcomes. 'Generative' routines (which occur where variation, selection and replication processes inform the routines) can be stable, but can also change and improve over time, based on reflection and adaption (Hodgson, 2008; Pentland *et al*., 2012). Pentland (2011) further argued that this gives rise to more empirical opportunities for engaging with the 'real' routines in an organisation. Routines can therefore promote stability and consistency as well as change and growth and they can also be the 'memory banks' of organisational knowledge and can be considered the microfoundations of capabilities (Parmigiani and Howard-Grenville, 2011).

In respect of the relevance of "microfoundations", Felin and Foss (2009) argue that there was a need for microfoundations due to the theoretical drift and a lack of theoretical clarity on the concept of organisational routines and capabilities. Subsequently, Barney and Felin (2013) proposed that there was still little consensus on microfoundations. However, although acknowledging concerns over the gap in organisational routines and capabilities research in relation to the individual rather than the organisation Winter (2013) raised an "irreducibility" argument in respect to the actual need for microfoundations, or expressed another way, "are microfoundations basically an unnecessary meaningless reductionist exercise?" (Devinney, 2013, 81).

The ongoing debates over the perceived relevance of microfoundations, or the definition of routines, are not specific to construction management. The small number of publications associated with Absorptive Capacity Routines within the field of construction, might simply be a result of the embryonic nature of the empirical research into the routines associated with dynamic capabilities (such as Absorptive Capacity) in the construction sector (Chen and Fong, 2012). A Google Scholar search on the 19th May 2016 for 'Absorptive Capacity Routines' within 'Construction Management'; 'Construction Industry' or the 'Construction Sector', resulted in under 15 publications. Learning routines and mechanisms associated with building Absorptive Capacity capabilities accounted for the highest proportion of articles to date. Publications included the use of learning routines and mechanisms by construction companies: to reconfigure operating routines to support positive firm performance during turbulent business environments (Chen and Fong, 2012); to potentially influence Value for Money on current and future collaboration projects (Chen *et al.'s*, 2013); to underpin collaborative learning capabilities which positively impacts on operating routines and firm performance (Manley and Chen, 2015); to positively impact firm performance (Chen and Fong, 2015); to create a feedback loop in learning cycles (Manley and Chen, 2015b).

More specifically, in assessing the observable learning routines employed at corporate level, across knowledge exploration, transformation and exploitation on collaborative Australian infrastructure projects, Lewis *et al*., (2014) reported that 'regularly applying new knowledge to collaborative projects' was the most often implemented routine and 'staff incentives to encourage information sharing about collaborative projects' the least popular routine. In addition to 'learning routines', other routines were also harnessed to observe Absorptive Capacity capabilities in the context of construction. For example, Ebers and Maurer's (2014) survey of German engineering firms, used routines (relating to tie strength and trust, project-level decision-making discretion, process and product innovation, training, 'potential' ideas generation and 'realised' ideas passed between projects) to conclude that "the whole of Absorptive Capacity is greater than its parts" (2014, 318).

Kozica *et al*., (2014) refined Lewin *et al*.'s (2011) Metaroutine Framework, to take account of the "permeable and fluid" boundaries associated with the use of Freelancers (e.g. independent contractors) when dealing with acquiring external knowledge and proposed that Absorptive Capacity "itself is a construct that can be interpreted as a capacity that reaches across the boundary of an organisation" (2014, 429). Manley *et al*.'s. (2014) Australian road construction industry survey of routines associated with, amongst others, reciprocity, common language, communication, responsibility and application (utilising Jiménez-Barrionuevo *et al*., (2011) 18 'measures' of obtaining and exchanging new and novel information and knowledge to support a firms activities), concluded that "organisations do build capacity differentially within each of the four phases defined by Zahra and George (2002), and that these differences can be observed between phases within each sector of the Australian road infrastructure supply chain, and between the sectors" (2014, 13-14).

Finally, Cooper and Molla (2016) operationalised Information System (IS) environmental Absorptive Capacity through developing associated knowledge routines. They found that an 'IS departments' ability to acquire external sustainability knowledge from relationships with stakeholders such as customers and suppliers' was the most widely developed routine and an 'IS departments' ability to acquire new external knowledge by sending IS personnel to complete green IT training' was the least widely developed environmental Absorptive Capacity routine. From the examples cited we propose that the evidence from the literature, of the use of Absorptive Capacity Routines within construction, is still relatively minimal, with a focus on 'learning routines' and geographically centred around Australian case studies. How might further research into dynamic capabilities, routines and microfoundations support performance improvements within the construction sector?

Future areas for research.

Through observing the impacts of underperforming Absorptive Capacity Routines (whether at project, individual, firm or sector levels), actions can be taken to address contemporary performance concerns raised by policy makers and sector bodies. Reviewing contemporary UK Government and policy objectives and measures, three examples are suggested to support the argument for further research into the use of routines, to not only operationalise the levels of Absorptive Capacity capabilities within the UK construction sector, but also to support the delivery of performance improvements in practice.

Firstly, Absorptive Capacity is often considered weak in construction. Yet, there is growing evidence that suggests that the levels of Absorptive Capacity differ across the

diverse professions within the construction sector and as such a 'broad brush' approach to Absorptive Capacity does not accurately reflect levels within the sector. Our first example contrasts findings in respect of Absorptive Capacity levels across professions from a practice and theoretical perspective. BIS (2013) reported that "Research shows that firms which export generally tend to be larger, more productive, have higher Absorptive Capacity ('know how') and be more likely to engage in research and development or wider innovation activity than those that do not export" (2013, 9). In terms of UK construction exports, BIS (2013) reported that the levels of exports vary across differing activities. The BIS (2013) report highlighted that the UK showed strong export performance in respect of architecture and surveying services; improving performance in respect to construction contracting; but performed less well in respect of UK construction trade/suppliers exports. Manley *et al*.'s (2014) use of Absorptive Capacity Routines to investigate the levels of Absorptive Capacity across the professions involved in the Australian road construction industry, reported higher levels of Absorptive Capacity for suppliers and contractors across all four (acquisition, assimilation, transformation and exploitation) stages than for consultants, with suppliers also outperforming contractors in assimilation and transformation stages.

If Manley *et al*.'s (2014) findings were reinterpreted in the context of UK construction export performance, then you could suppose that trade/suppliers would outperform architects in terms of export performance. However, this is not the case, BIS (2013) actually reported the opposite outcome. Not excluding the possibility that there may be commercial differences to consider between Australia and the UK, the use by Manley *et al* (2014) of routines to investigate the capabilities of the sector, as opposed to using analogous proxies, could also explain the mismatch. In questioning if the conventional Absorptive Capacity proxies are too 'broad' to fully represent the realities across the diverse professions involved in construction, we propose there is further scope, through the use of observable Absorptive Capacity Routines, to better understand the impacts of Absorptive Capacity on sector performance outcomes (for example, export performance).

Secondly and associated with the first point above, Absorptive Capacity is often considered through static mechanisms, which are poor proxies of how learning takes place. Therefore, revisiting routines as a great source of creativity and continuous change, or "effortful accomplishments", opens up avenues for examining absorptive capacity. Hence, creating opportunities to implement more effective practices to address sector shortcomings, through observing how individuals create and change routines (to deliver not just personal but project objectives. For example, through developing coordination and collaboration practices, across all levels of the industry, to raise awareness of inefficiencies currently embedded within standard construction practices; or as a result of skills shortages and the challenges created through the increased use of a self-employed workforce. Or, through developing routines to more successfully capture, exploit and disseminate productive research, knowledge and innovation (HM Government, 2013; BIS, 2013).

Finally, construction is often conceived as project-based. Instead of focusing on purely the project-based discourse, however, future research could look at how routines endure beyond the project, which in turn might shed some light as to how the Absorptive Capacity of construction (firms and industry) can be strengthened. Sector performance in terms of project lifecycles (design through to defects) is monitored through the UK construction Key Performance Indicators (KPIs) (Glenigan, 2014). As an example, clients' ratings on the impact of project defects at handover illustrate

that since 2006, satisfaction levels have followed a downward trajectory, and that there is a marked difference between rating and project size. So, for projects between £1m and £5m, the negative impact of defects at hand over stage were significantly higher than for projects with a value over £5m. A second KPI, which in 2014 scored less than at the commencement of the benchmarking programme in 2003, related to the proportion of All Non-Housing projects where design time either achieved or bettered the anticipated design phase programme. In comparison, the same KPI for All Housing projects illustrated little change in performance. In a curious twist, the results for the time predictability combining design and construction, was reversed.

The UK construction benchmarking KPIs have highlighted trends, but can observing dynamic routines associated with say, assimilation (e.g. common language), transformation (e.g. communication, documentation and transmission) and exploitation (e.g. responsibility and application) (Jiménez-Barrionuevo *et al*., 2011) provide insight on what impact project size might have on levels of project defects at handover stage? Or, could research into the routines associated with the acquisition (e.g. interaction and reciprocity) or transformation of new knowledge, provide insight in to why design programmes are more likely to be adhered to in relation to house building rather than non-house building? In respect of this second question, a simple answer might be that housing tends to be less radical or bespoke, so you might expect less design issues, but if that were to be the case, then the pattern would be reflected in the combined design and construction time predictability KPI, which it is not? So, from a practice perspective, insight into the differences between housing and non-housing design time predictability would be highly beneficial. From a theoretical perspective, the final suggestion on areas for further research, also raises intriguing question on the 'durability' of routines beyond a project and differing levels of absorptive capacity across the lifecycle of a project.

CONCLUSIONS

Allas (2014), positively linked innovation performance, growth and productivity levels with Absorptive Capacity. However, “we still know little about why some organizations possess greater Absorptive Capacity than others” (Ebers and Maurer, 2014, 318) and more specifically, “how the different proposed components of Absorptive Capacity individually, together and through their interactions affect relevant outcomes” (2014, 319). We propose that further investigation in to Absorptive Capacity Routines could provide further insight into how the diverse and complex construction sector could coordinate and collaborate to ensure that “the whole is more than the sum of the parts” (HM Government, 2013, 54). As detailed above, there are many areas where a fuller understanding of the practical application of routines, which are observable and therefore open to monitoring and evaluation, could provide productive guidance for the construction sector to achieve performance improvements. Not just in terms of ‘tangible' outcomes (e.g. a reduction in project defects), but also in terms of ‘intangible resources’ (e.g. lessons learned through project handover for exploiting in future projects).

As a project based sector, where the workforce regularly move between projects and where companies work within diverse and complex alliances and networks, rather than treating knowledge transfer between individuals, organisations or the sector as a static ‘asset’ to be counted, the observation and monitoring of collaboration and communication routines, that create a conducive environment for knowledge absorption across boundaries (Kozica *et al*., 2014), should reflect more accurately the

dynamic capabilities embedded within the sector. With the majority of the construction studies to date discussing 'learning routines', there is scope to consider creative and dynamic Absorptive Capacity Routines associated with capabilities, such communication and collaboration, or prior related knowledge, internalisation or incentives etc.

Finally, Manley *et al*., (2014) reported that construction clients exhibit low assimilation and exploitation capacities and only moderate levels of acquisition and transformation capabilities. There is a pleasing circular flow evident in this final example of the dynamic possibilities of Absorptive Capacity Routines. Could insight be gained into design time predictability performance issues, through a better understanding of how a client's exploiting knowledge routines, combine with an architect's knowledge assimilation routines? In a similar vein, could insight also be gained into measures to reduce the impact of defects at handover stage, through greater clarity on how a client's assimilation routines combine with a contractor's knowledge transformation routines? In raising the question as to how we might better understand the dynamics of the impacts of Absorptive Capacity, could further research into Absorptive Capacity Routines, deliver the means for the UK construction sector to move beyond the 'headlines' of weak performance and develop not just incremental performance improvements but positive radical change, based on a true understanding of the Absorptive Capacity of the sector.

REFERENCES

Allas, T (2014) *Insights from International Benchmarking of the UK Science and Innovation System*. London: Department for Business Innovation & Skills (BIS) Analysis Paper, 3, 1-55.

Barney, J and Felin, T (2013) What are microfoundations? *The Academy of Management Perspectives*, **27**(2), 138-155.

Department for Business, Innovation and Skills (BIS UK) (2013) *Construction: An Economic Analysis of the Sector July 2013*. London: Department for Business, Innovation and Skills.

Blayse, AM and Manley, K, 2004 Key influences on construction innovation. *Construction Innovation*, **4**(3), 143-154.

Brady, T and Davies, A (2014) Managing structural and dynamic complexity: A tale of two projects. *Project Management Journal*, **45**(4), 21-38.

Bygballe, L E and Ingemansson, M (2014) The logic of innovation in construction. *Industrial Marketing Management*, **43**(3), 512-524.

Chen, L and Fong, P S (2012) Visualizing evolution of knowledge management capability in construction firms. *Journal of Construction Engineering and Management*, **139**(7), 839-851.

Chen, L and Fong, P S (2015) Evaluation of knowledge management performance: An organic approach. *Information & Management*, **52**(4), 431-453.

Chen, L, Manley, K and Lewis, J, 2013, May The impact of construction organisations' learning capabilities on collaborative projects. *In*: *Proceedings of the 19th International CIB World Building Congress*, Queensland University of Technology

Cohen, W M and Levinthal, D A, 1990. Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly*, **35**(397), 128-152.

Cooper, V and Molla, A (2016) Information systems Absorptive Capacity for environmentally driven IS-enabled transformation Information Systems Journal [Early View DOI: 10.1111/isj.12109]

Davies, A, Gann, D and Douglas, T (2009) Innovation in megaprojects: systems integration at London Heathrow Terminal 5. *California Management Review*, **51**(2), 101-125.

Davies, A, MacAulay, S, DeBarro, T and Thurston, M (2014) Making innovation happen in a megaproject: London's Crossrail suburban railway system. *Project Management Journal*, **45**(6), 25-37.

Devinney, TM, 2013 Is microfoundational thinking critical to management thought and practice? *The Academy of Management Perspectives*, **27**(2), 81-84.

Dionysiou, D D and Tsoukas, H (2013) Understanding the (re)creation of routines from within: A symbolic interactionist perspective. *Academy of Management Review*, **38**(2), 181-205.

Ebers, M and Maurer, I (2014) Connections count: How relational embeddedness and relational empowerment foster Absorptive Capacity. *Research Policy*, **43**(2), 318-332.

Feldman, M S (2000) Organizational routines as a source of continuous change. *Organization Science*, **11**(6), 611-629.

Feldman, M S and Pentland, B T (2003) Reconceptualizing organizational routines as a source of flexibility and change. *Administrative Science Quarterly*, **48**(1), 94-118.

Gann, D (2001) Putting academic ideas into practice: Technological progress and the Absorptive Capacity of construction organizations. *Construction Management and Economics*, **19**(3), 321-330

Hodgson, GM (2008) 2 The concept of a routine *In*: M C Becker (Ed.) *Handbook of Organizational Routines*. Cheltenham, Gloucester: Edward Elgar Publishing, 15.

Felin, T and Foss, N J, 2009 Organizational routines and capabilities: Historical drift and a course-correction toward microfoundations. *Scandinavian journal of management*, **25**(2), 157-167.

Flatten, T C, Engelen, A, Zahra, S A and Brettel, M (2011) A measure of Absorptive Capacity: Scale development and validation. *European Management Journal*, **29**(2), 98-116.

Foss, N J, Lyles, M A and Volberda, H W (2010) Absorbing the concept of Absorptive Capacity: How to realize its potential in the organization field. *Organization Science*, **21**(4), 931-951.

Glenigan (2014) UK *Industry Performance Report 2015: Based On The UK Construction Industry Key Performance Indicators*. Glenigan/CITB/Consulting Excellence/BRE SMARTWaste.

Jiménez-Barrionuevo, M M, García-Morales, V J and Molina, L M (2011) Validation of an instrument to measure absorptive capacity. *Technovation*, **31**(5), 190-202.

Kozica, A, Bonss, U and Kaiser, S (2014) Freelancers and the absorption of external knowledge: Practical implications and theoretical contributions. *Knowledge Management Research & Practice*, **12**(4), 421-431.

Lewin, A Y, Massini, S and Peeters, C (2011) Microfoundations of internal and external Absorptive Capacity Routines. *Organization Science*, **22**(1), 81-98.

Lewis, J, Chen, L and Manley, K (2014) Learning routines used by firms during construction of infrastructure projects using the alliance procurement method. *In*: *Proceedings of the CIB 2014 International Conference on Construction in a Changing World, 4-7 May 2014, Heritance Kandalama, Sri Lanka. The University of Salford/International* Council for Building (CIB), 1-17.

Manley, K, Rose, T and Lewis, J (2014) The distribution of Absorptive Capacity among construction supply chain participants. *In*: *Proceedings of the CIB 2014 International Conference on Construction in a Changing World,* 4-7 May 2014, Heritance Kandalama, Sri Lanka. The University of Salford/International Council for Building (CIB), 1-16.

Manley, K and Chen, L (2015) Client learning and the performance of collaborative infrastructure projects. *In*: the *Proceedings of the 6th International Conference on Engineering, Project, and Production Management (EM2015)* 2-4 September 2015, Gold Coast, Queensland, Australia. Griffith School of Engineering: Griffith University, 508-517.

Manley, K and Chen, L (2015b) Collaborative learning model of infrastructure construction: a capability perspective. Construction Innovation, 15(3), 355-377.

Parmigiani, A and Howard-Grenville, J (2011) Routines revisited: Exploring the capabilities and practice perspectives. *Academy of Management Annals*, **5**(1), 413-453.

Pentland, B.T., 2011. The foundation is solid, if you know where to look: comment on Felin and Foss. Journal of Institutional Economics, 7(02), pp.279-293.

Pentland, B T, Feldman, M S, Becker, M C and Liu, P (2012) Dynamics of organizational routines: A generative model. *Journal of Management Studies*, **49**(8), 1484-1508.

Reichstein, T, Salter, A J and Gann, D M (2005) Last among equals: A comparison of innovation in construction, services and manufacturing in the UK. *Construction Management and Economics*, **23**(6), 631-644.

Reichstein, T, Salter, A J and Gann, D M (2008) Break on through: Sources and determinants of product and process innovation among UK construction firms. *Industry and Innovation*, **15**(6), 601-625.

Teece, D J, Pisano, G and Shuen, A (1997) Dynamic capabilities and strategic management. *Strategic Management Journal*, **18**(7), 509-533.

Todorova, G and Durisin, B (2007) Absorptive Capacity: valuing a reconceptualization Academy of Management Review, **32**(3), 774-786.

HM Government (2013) *UK Government Industrial Strategy: government and industry in partnership, Construction 2025*. HM Government: London.

Winch, G (1998) Zephyrs of creative destruction: Understanding the management of innovation in construction. *Building Research and Information*, **26**(5), 268-279.

Winch, G M (2003) How innovative is construction? Comparing aggregated data on construction innovation and other sectors: A case of ales and pears. *Construction Management and Economics*, **21**(6), 651-654.

Winter, S G (2013) Habit, deliberation, and action: Strengthening the microfoundations of routines and capabilities. *The Academy of Management Perspectives*, **27**(2), 120-137.

Zahra, S A and George, G (2002) Absorptive Capacity: A review, reconceptualization, and extension. *Academy of Management Review*, **27**(2), 185-203.

Zollo, M and Winter, S G (2002) Deliberate learning and the evolution of dynamic capabilities. *Organization Science*, 13(3), 339-351.

EXPLORATION OF THE SYNERGIES BETWEEN ACTIVITY THEORY AND THE DMAIC METHOD IN EVALUATING CONSTRUCTION PROCESSES

Martina Murphy[1]

School of the Built Environment, University of Ulster, Shore Road, Newtownabbey, County Antrim, BT37 0QB, UK

Since Taylor advocated the analysis of workflows as a means to improving efficiency and productivity, construction processes have been evaluated using quantitative improvement techniques such as value engineering and Six Sigma. These methods don't account for the effect of stakeholder influences and impacts. In a people-centric sector, such as construction, stakeholder influences may sustain problems in spite of technical improvements. The purpose of this paper is to (1) assess the approaches used for process improvement in evaluating construction problems and (2) determine the potential for combining quantitative and qualitative methods of investigation to extract more precise insights as to the cause of a problem. A case study was investigated using a 2-stage methodology comprising (a) a DMAIC analysis of an identified problem to determine a quantitative solution and (b) Activity Theory analysis to determine the impact of project stakeholders on the problem. It was identified that whilst DMAIC generated technical improvements, Activity Theory analysis identified the underlying root causes of the process failure through qualitative analysis namely lack of professional knowledge, culture and previous experience. The dual-method approach shows how quantitative factors combined with qualitative analysis can provide a cross check to ensure robustness of findings in producing sustainable project outcomes.

Keywords: Activity Theory, DMAIC, worker activity, methodology, process improvement

INTRODUCTION

In an attempt to improve project productivity the construction industry has explored sectors such as manufacturing to examine the effectiveness of adopting improvement tools such as Just in Time, Lean Manufacturing, and Six Sigma (Stewart and Spencer, 2006; Büyüközkan and Öztürkcan, 2010). However increasing evidence has shown that such methods are failing to produce the long-term sustainable benefits required in construction (De Mast and Lokkerbol, 2012; Sin *et al*., 2015). Furthermore, it is suggested that this inefficiency lies in the failure to effectively recognise and make allowance for the influence and impact of project stakeholders when investigating process problems (Stewart and Spencer, 2006; Sunder, 2016). This paper seeks to assess the nature of a quantitative improvement approach, such as Six Sigma, to investigate a construction process problem and the potential value of combining such an approach with stakeholder-focused qualitative analysis, namely Activity Theory, in

[1] m.murphy@ulster.ac.uk

Murphy, M (2016) Exploration of the Synergies between Activity Theory and the DMAIC Method in Evaluating Construction Processes. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1039-1048.

order to determine more holistic improvements. It is proposed that such a dual-method approach can provide a cross check to ensure robustness of findings in producing sustainable project outcomes.

DMAIC is an acknowledged and respected approach to problem solving from the field of engineering whilst AT has similar deference paid to it from the field of educational psychology. The trans-industry adoption of techniques and theories across seemingly disparate sectors is not uncommon (Tatum, 1987; Pries and Janszen, 1995). However historically there has been more resistance to this from the construction sector than other sectors (Bowley, 1960). The purpose of this paper is to (1) assess the approaches used for process improvement in evaluating construction problems and (2) determine the potential for combining quantitative and qualitative methods of investigation to extract more precise insights as to the cause of a problem.

LITERATURE

One of the earliest theorists of process improvement was Frederick Winslow Taylor. Taylor's work initiated the Scientific Management movement to show how work was performed within his steel company and the impact that it had on work productivity (Taylor, 1914). Taylor hypothesised that making people work as hard as they could was not as efficient as optimising the way the work was done. He proposed that by optimising and simplifying jobs, productivity would increase. In essence, Taylorism breaks down tasks from a large process into more management steps. However, Taylor separated the capability to do 'manual' work from the competence of the workers to undertake 'mental' work to inform or improve their work. In this respect scientific management in its purist form focuses on the mechanics of a process and fails to recognise the potential value or 'mental' contribution of the people implicit in the process.

Modern management practices have sought to incorporate workers ideas, experience and knowledge into practice in order to understand what motivates and drives individuals to perform a task more efficiently and thus improve performance (Mayo, 1924; Maslow, 1943; Herzberg, 1968). Whilst such theories had beneficial impacts for workers experience and workplace conditions they were subject to ongoing criticism that their impact on profit generation was minimal; profit generation being the primary driver of Taylor's original studies. Later studies by Womack on the Japanese car industry in the 1980's proposed that a strategy of optimising flow, minimising waste and continuous improvement can be achieved in conjunction with workers 'mental' involvement and advancement (Womack *et al*., 1990). This promoted a plethora of industry reports which stimulated the widespread and uncritical adoption of manufacturing techniques into the construction industry (Egan, 1998; Latham, 1994). Whilst this approach was challenged (Winch, 2003) there still sustains the notion that systematic and quantitative analysis is the optimum approach to evaluating construction problems (Dainty, 2008).

Seymour questioned the perceived traditional dominance of the rationalist position to investigating construction (Seymour *et al*., 1997). Seymour suggested an overreliance on the scientific theorising, associated with quantitative methods, had developed within the field of construction to the detriment of more interpretive approaches. A key element of Seymour's argument was that the 'object' of most construction management research is people and hence investigatory methods should be aimed at understanding the social structure and patterns of interaction between those working within, and affected by, the built environment.

Dainty investigated the extent to which construction is investigated using alternative research paradigms (Dainty, 2008). He found that the research community has largely continued to adopt a rationalist paradigm in evaluating construction and suggested that no single methodology can provide a holistic picture of industry practice. Also that mixing paradigms advances the research community towards a "more balanced methodological outlook" to understand the industry's complex nature which informs its process problems. The use of both qualitative and quantitative methods constitutes a valid approach either separately or combined (Knight and Ruddock, 2008).

More recently, studies have exhibited an increasing tendency to address these concerns. Leicht explored the use of observational studies as a valid and insightful approach to investigate the process (Leicht *et al*., 2009). Hartmann and Bresnen cite a lack of multiple perspectives on the concept of partnering in construction projects (Hartmann and Bresnen, 2011). They examined collaborative practice from an Activity Theory perspective in order to extract deeper insights into the evolution of partnering relationships. In adopting an Activity Theory approach, Hartmann and Bresnen confirmed Dainty's earlier concerns regarding the importance of reflexivity in the execution of a qualitative approach, more specifically, in evaluating behavioural patterns and identifying accurate sources of divergent perceptions and meanings (Hartmann and Bresnen, 2011). Gluch and Räisänen have used Activity Theory to examine the problems between project practice and environmental management. They focused on tensions that occur between human agents and material objects within a complex Activity System, namely that of managing environmental issues in projects (Gluch and Räisänen, 2012). Similarly, Fetais (2010) applied Activity Theory to investigate the interactions of people and project management systems at the conceptual cost estimate stage of the construction procurement process. He argued that in management research new insights require creative yet academically robust approaches that address multiple dimensions and perspectives of the complex and often ambiguous socio-cultural contexts situations they seek to analyse.

Six Sigma is defined by Linderman *et al*., (2003) as an organized and systematic method for strategic process improvement. It is delivered by means of the DMAIC process (Su and Chou, 2008). DMAIC is an acronym for five interconnected phases: Define, Measure, Analyse, Improve, and Control and is a process of continuous improvement through these five phases (Linderman *et al*., 2006; Pande and Holpp, 2002; Schroeder *et al*., 2008; Kumar and Sharma, 2012). It is a systematic and evidence based approach which uses a set of tools to provide a framework of results.

Activity Theory (AT)

Activity Theory (AT) is a qualitative observational approach to determine how an action of an individual or group is embedded in a context of collective practice (Kaptelinin and Nardi, 1997). According to Redmiles (2002), AT offers a means of examining a phenomenon through deconstruction and analysis of the relationships. It encompasses, relationships of objectives, communities, rules and division of labour. The underlying principles of AT are: hierarchical structure of activity, object-orientedness, mediation, continuous development and distinction between internal and external activities. The core element of AT is the Activity System (AS); a collective human construction that cannot be reduced to discrete individual actions (Engeström *et al*., 1999). The basic model of an Activity System is shown in Figure 1.

In explaining the AS the term 'subject' describes the person or people carrying out the activity. Activities are directed towards an 'object-oriented' goal. Achievement of

goals ('objects') is mediated by 'artefacts' which together with human beings make up the socio-cultural matrix. Artefacts can be both mental and physical such as software or lack of understanding. The same artefact can be used in different ways, depending on the rules for using it, rules which can be influenced by the community in the Activity System. Additionally boundary objects are information, such as specimens, field notes, and maps, used in different ways by different communities (Star, 1989). Boundary objects exist at the point where knowledge domains meet which makes it possible to explore differences in language that can facilitate knowledge sharing.

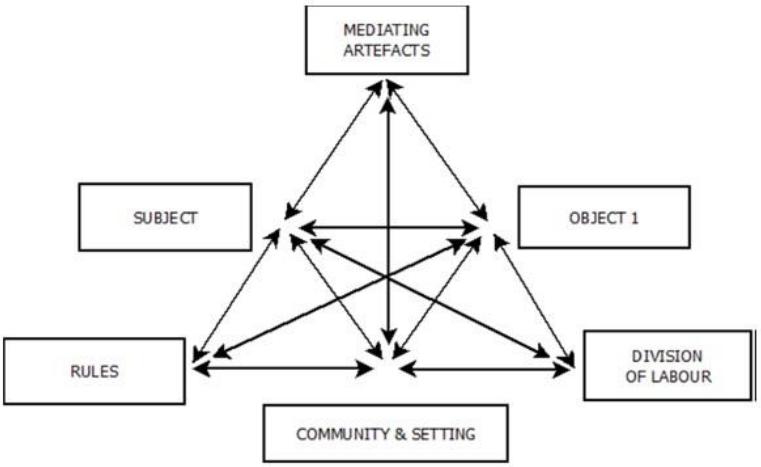


Fig 1 Activity Theory: The Activity System. Source: Adopted from Engeström, 1999)

'Rules' can be both explicit and implicit to ensure the project is carried out correctly. Different 'communities and settings' may apply different rules to the same tools. This also illustrates the 'division of labour', the way in which authority, tasks and benefits are allocated among participants, also influences the activity and subsequent Activity System. In a project delay situation, there will have been disturbances to the system in the past, perhaps in the division of labour (such as a change of project manager) or the tools (different submission techniques or software programmes) which will have resulted in changes to the structure of the Activity System. The output from one typically becomes the input to another system or combines with one or more to generate further Activity Systems or a Chain of Activity Systems. Any disturbance in one Activity will have an impact on adjacent Activity Systems in the Chain.

METHOD

A case study was identified which had a documented problem relating to its Reviewable Design Data (RDD) process which required resolution. It was initially determined to resolve the problem using DMAIC however following consultation with the project stakeholders it was agreed to pilot the dual-method approach of investigation to address the problem. The case study was a large multi-build PPP (Public Private Partnership) project for an Education Authority in the UK. The project involved the design and build of 11 schools in Scotland to meet government targets for the education provision in the Scottish Borders area. The total value of the works was £180 million with duration of 114 weeks. As part of the D&B contract an RDD process was programmed into the main works programme.

Reviewable Design Data (RDD) process is the iterative process of review and sign-off by a client of contractor-designed work packages in a D&B (Design and Build)

project towards final approval of the completed design. The work packages include design data which could not be fixed during the initial tender stage.

In the RDD process a design proposal is presented by the D&B Contractor to the Client at staged intervals during the project, and the Client is required to either reject or issue notices granting approval to proceed either with or without comments within a contractually defined timescale. It is implicit on the Contractor to ensure that there is a clear audit trail of comments and responses and that any additional stakeholder required to provide an input, such as an FM contractor, is included within the approvals process. The result is an interactive process of ever decreasing concerns or queries towards an agreed design solution.

The RDD process as a case study is an optimum investigatory tool for this study for two reasons. Firstly it facilitates application of the DMAIC technique of investigation by virtue of its sequential nature and fixed durations and secondly it lends itself to Activity Theory approach in having a cross-section of diverse stakeholders with traditionally adversarial attitudes with potentially polarising viewpoints.

DATA COLLECTION AND ANALYSIS

The investigation was undertaken using the DMAIC phases as a framework. Three teams were formed namely the Contractor, Client and Designers and each team was appointed a person trained in the DMAIC technique and each team was inducted in the AT protocol for data collection which involved iterative series of interviews combined with document collection and analysis.

Phase 1 - Definition

The first phase on DMAIC required the definition of the problem. A Process Map of the ‘current state’ of the problem was developed and a Pareto Analysis undertaken. This showed that there were increasingly unsustainable delays being caused to the overall project programme due to the requirement to resubmit iterations of work packages to achieve Status A to close out the RDD process.

The Pareto analysis evidenced that‘Inadequate information provided’ was evidenced as the primary reason which produced significant overall effect (20%) on the problem against 11 other factors which had proportionally minimal significant impact.

In conjunction with the DMAIC interventions a series of semi-structured AT interviews were undertaken with key stakeholders. Initial observations identified strongly held professional allegiances amongst participants which evidenced in a reluctance to fully engage in a procurement method i.e. Design and Build, which, it was perceived, challenged their professional positions in the industry. Such reticence is considered to be a constraint in the DMAIC method and is considered an obstacle to be overcome whereas in AT such allegiances are considered ‘contradictions’ and are considered valuable determinants to understand an individual’s actions. This understanding is key in developing concise and holistic improvements for construction process problems.

Phase 2 - Measurement

Using DMAIC Value Stream mapping was carried out to analyse the current state and a Fishbone diagram was developed to categorise the potential causes of the problem in order to identify the root causes. Results revealed that the problem was two-fold. Firstly, the Client was required to return the approved design data through various iterations within the allocated 2 week period. However the Client was providing a

status decision of B or C by the end of the agreed period which then triggered an additional period of internal review before re-submission for another 2 week period. This was making the RDD process a possible 6 week process with no assurance that a Status A. Whilst the Client was within their contractual rights to extend the review period it was becoming increasingly problematic for the Contractor to maintain project programme and additionally was becoming a drain on administrative and human resources.

As part of the AT approach, a second iteration of structured interviews was undertaken to allow participants the opportunity to respond to the results of the root cause analysis according to their role and experience (Fellows and Liu, 2015). Participants were asked about their involvement in the RDD process, methods and software used, involvement of other people in related activities, experience of problems caused by the process, their own skills, knowledge and experience and their ideas for improvement. The interviews were recorded and transcribed.

Phase 3 - Analysis

Data from the DMAIC method was evaluated by reductive analysis using Failure Mode and Effect Analysis (FMEA). Qualitative cross-factor analysis from the AT interviews was undertaken and results were correlated using SPSS techniques. The resultant Activity System is shown in Figure 2.

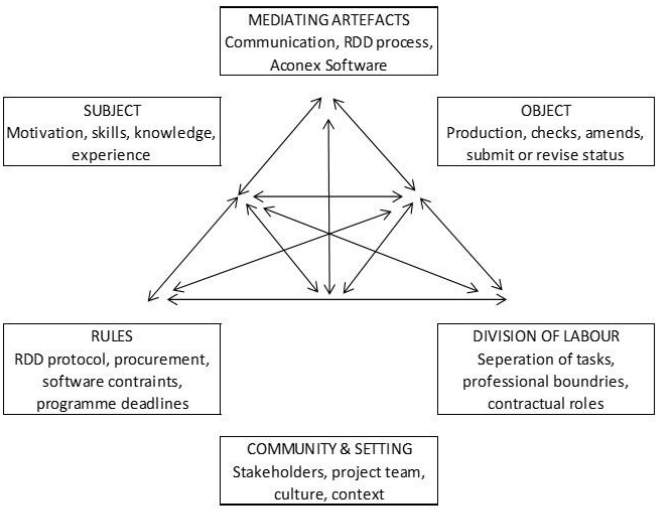


Fig 2. Resultant activity system

Phase 4 - Improvement

Results showed that a significant risk to the process was caused by an overreliance on electronic communication to manage discussions about the RDD submissions. The key improvement identified using DMAIC was the scheduled use of face-to-face meetings prior to and during submissions. This would be monitored and controlled using an RDD Tracker; an electronic tracking system managed by the Contractor's Design Manager. However in AT, improvements are defined as continuous learning through negotiation of knowledge. Negotiated knowledge is knowledge created through a process of negotiating meaning while expertise is being shared. Whilst a practical solution is developed using DMAIC this is sustained by opening up the channels of communication through an on-going conversation and sharing of knowledge experiences and expertise. For example, one stakeholder will communicate their evaluation of the risk whilst another will moderate his suspicions

in line with these 'negotiations'. In this way, knowledge is constructed collaboratively and solutions are sustained.

Phase 5 - Control

As a result of the DMAIC outcomes, training, benchmarking and tracking was established in the project to facilitate opportunities for face-to-face communication. AT outcomes was the generation of 'conversations' or discussions within a culture of continuous improvement. This was facilitated through the newly established communication routes resulting from the DMAIC improvements.

FINDINGS AND CONCLUSIONS

Prior observations suggest that both DMAIC and AT methods are significantly opposing in their approach and outputs. DMAIC is quantitative method providing concise findings derived from a series of proven tools whilst AT is a qualitative approach facilitating a forum for representation of opinions from a range of sources. Theoretically both methods are not seemingly conducive to alignment however it is proposed that there is potential in combining these methods, or similar, to extract more precise insights as to the holistic causes of construction problems.

DMAIC operates through a sequential set of stages which examined the problem through reductive analysis. Its purpose was to strip away anomalies to produce a singular action for implementation. The DMAIC analysis revealed an increased risk to the process caused by an overreliance on electronic communication to manage discussions around the RDD submissions. AT examined the problem through deconstructive analysis of relationships through the subjective engagement with boundary objects and mediating artefacts. In this study the project used ACONEX, a powerful project management software (boundary object) which had been used previously by the contractor but was new to the other stakeholders. This could potentially have been used as a mediating artefact across stakeholders. However, the lack of experience of stakeholders in the use of the software compromised knowledge management. This adversely impacted the communication process which failed to be addressed timely by the contractor. Activity Theory seeks to understand a problem by determining the context through evaluating individual responses. The interviews showed that participants understood the problem under investigation but sought acknowledgement of their differences before being coerced into effecting systematic improvements.

Constraints identified using the DMAIC method were considered obstacles to be overcome whereas these were termed ‘contradictions’ within the AT system and were considered valuable determinants to understanding an individual’s actions. This was borne out in the observation that whilst DMAIC occurs through the generation of solutions AT learning occurs through negotiation of knowledge. Negotiated knowledge is knowledge created through a process of negotiating meaning whilst sharing knowledge. In this study when construction professionals discussed risks encountered in similar projects, one highlighted contractual risks and the other emphasised technical risks, then both individuals considered how these might apply to this project and both revised their knowledge accordingly. In order to reach agreement about a problem, stakeholders needed to share information about their experience and views so that they could share understanding and hence knowledge through a process of argument, listening to, and then challenging, each other’s

viewpoints. One stakeholder looked at risks differently, whilst the other moderated his suspicions. In this way, knowledge was constructed collaboratively.

Culture and context is vital to determining the sustainability of a solution. In a complex human network such as construction it is imperative to be cognisant of the impacts of external influences on a construction process. In this study AT showed that the D&B procurement structure was problematic for the architect. It promoted an enforced separation from the client which impacted attitudes and placed blame on the contractor as the intermediary party and hence actions i.e. the submission of incomplete drawing packages. This was also compounded by contractor failure to proactively engage with the problem well as the client's lack of knowledge which exhibited itself as uncertainty. This may also have its cultural roots in the historical separation of the professional bodies and trade representatives of the respective stakeholders.

In summary both methods reached the same conclusions i.e. the need for increased face-to-face collaboration within a context and culture of increased understanding. The difference being that whilst DMAIC facilitated the findings in practical outcomes AT exposed the rationale and drivers for these improvements. This form of improvement sustains as long as the impetus is present to drive it namely the key stakeholders. It is imprecise to assume that one approach can fully determine the final solution to a construction problem. However whilst this study represents initial investigation of this the hypothesis it suggests that there is potential to undertaking dual-method analysis to examine construction process problems. It is proposed that further research is required to extend the study findings and include a range of construction processes and input from diverse stakeholders.

REFERENCES

Bowley, M (1960) *Innovation in Building Materials*. London: Gerald Duckworth.

Büyüközkan, G, and Öztürkcan, D (2010) An integrated analytic approach for Six Sigma project selection. *Expert Systems with Applications*, **37**(8), 5835-5847.

De Mast, J, and Lokkerbol, J (2012) An analysis of the Six Sigma DMAIC method from the perspective of problem solving. *International Journal of Production Economics*, **139**(2), 604-614.

Dainty, A (2008) Methodological pluralism in construction management research. *In*: A Knight and L Ruddock (Eds.) *Advanced research methods in the built environment*. London: Wiley Blackwell, 1-13.

Egan, J (1998) *Rethinking Construction*. Report from the Construction Task Force.

Engeström, Y, Miettinen, R, and Punamäki, R L (1999) Perspectives on activity theory. Cambridge: Cambridge University Press.

Fellows, R F, and Liu, A M (2015) *Research Methods for Construction*. New York: John Wiley and Sons.

Fetais, A H (2010) The significance of the people factor in project cost estimates. *In*: *Qatar Foundation Annual Research Forum Proceedings (No 2010, AHP9)*, Bloomsbury: Qatar Foundation Journals.

Gluch, P and Räisänen, C (2012) What tensions obstruct an alignment between project and environmental management practices? *Engineering, Construction and Architectural Management*, **19**(2), 127-140.

Hartmann, A, and Bresnen, M (2011) The emergence of partnering in construction practice: An activity theory perspective. *The Engineering Project Organization Journal*, **1**(1), 41-52.

Herzberg, F (1968) *One More Time: How Do You Motivate Employees*. Boston: Harvard Business Review, 46-57.

Kaptelinin, V and Nardi, B A (1997) *Activity Theory: Basic Concepts and Applications. In*: CHI'97 Abstracts on Human Factors in Computing Systems ACM, 158-159.

Knight, A and Ruddock, L (Eds.) (2008) *Advanced Research Methods in the Built Environment*. Chichester, West Sussex: Wiley-Blackwell.

Kumar, A and Sharma, N (2012) Six Sigma DMAIC methodology: A powerful tool for improving business operations. *Advanced Materials Research*, **488**, 1147-1150, Trans Tech Publications.

Latham, M (1994) *Constructing the Team: Joint Review of Procurement and Contractual Arrangements in the UK*. Construction Industry Government Report.

Leicht, R M, Hunter, S T, Saluja, C and Messner, J I (2009) Implementing observational research methods to study team performance in construction management. *Journal of Construction Engineering and Management*, **136**(1), 76-86.

Linderman, K, Schroeder, R G, Zaheer, S, and Choo, A S (2003) Six Sigma: A goal-theoretic perspective. *Journal of Operations Management*, **21**(2), 193-203.

Linderman, K, Schroeder, R G, and Choo, A S (2006) Six Sigma: The role of goals in improvement teams. *Journal of Operations Management*, **24**(6), 779-790.

Maslow, A H (1943) A theory of human motivation. *Psychological review*, **50**(4), 370.

Mayo, E (1924) Revery and industrial fatigue. Williams and Wilkins Company.

Pande, P S, Holpp, L, and Pande, P (2002) *What is six sigma? Volume 1*. New York, NY: McGraw-Hill.

Prasad, K D, Subbaiah, K V, and Padmavathi, G (2012) Application of Six Sigma methodology in an engineering educational institution. *International Journal of Emergency Science*, **2**(2), 222-237.

Pries, F and Janszen, F (1995) Innovation in the construction industry: the dominant role of the environment. *Construction Management and Economics*, **13**(1), 43-51.

Redmiles, D (2002) Introduction to the special issue on activity theory and the practice of design. *Computer Supported Cooperative Work (CSCW)*, **11**(1), 1-11.

Schroeder, R G, Linderman, K, Liedtke, C, and Choo, A S (2008) Six Sigma: Definition and underlying theory. *Journal of Operations Management*, **26**(4), 536-554.

Seymour, D, Rooke, J and Crook, J (1997) The role of theory in construction management: A call for debate. *Construction Management and Economics*, **15**(1), 117–119.

Sin, A B, Zailani, S, Iranmanesh, M and Ramayah, T (2015) Structural equation modelling on knowledge creation in Six Sigma DMAIC project and its impact on

organizational performance. *International Journal of Production Economics*, **168**, 105-117.

Star, S L (1989) The structure of ill-structured solutions: heterogeneous problem-solving, boundary objects and distributed artificial intelligence. *Distributed Artificial Intelligence*, **2**, 37-54.

Stewart, R A, and Spencer, C A (2006) Six-sigma as a strategy for process improvement on construction projects: A case study. *Construction Management and Economics*, **24**(4), 339-348.

Su, C T, and Chou, C J (2008) A systematic methodology for the creation of Six Sigma projects: A case study of semiconductor foundry. *Expert Systems with Applications*, **34**(4), 2693-2703.

Sunder, M V (2016) Lean six sigma project management: A stakeholder management perspective. *The TQM Journal*, **28**(1), 132-150.

Tatum, C B (1987) Process of innovation in construction firms. *Construction Engineering and Management*, **113**(4), 548-663.

Taylor, F W (1914) *The Principles Of Scientific Management*. New York: Harper.

Winch, M G (2003) How innovative is construction? Comparing aggregated data on construction innovation and other sectors - a case of apples and pears. *Construction Management and Economics*, **21**(1), 651-654.

Womack, J P, Jones, D T, and Ross, D (1990) *The Machine that Changed the World*. New York: Rawson and Associates.

REAL ESTATE DEVELOPMENT BY ARCHITECTURAL FIRMS: IS THE BUSINESS MODEL FUTURE-PROOF?

Marina Bos-de Vos[1], Leentje Volker and Hans Wamelink

Faculty of Architecture and the Built Environment, Technical University of Delft, Julianalaan 134, 2628 BL Delft, The Netherlands

Architectural firms need business models that are able to deal with the diversity and uncertainty of their work to run a successful business over time. Little is known about the business models that are used in architectural service delivery and how they enable or constrain firms to create and capture value in their projects. In this research, a theoretical framework is used to systematically analyse the business models for the delivery of real estate development services by architectural firms. The findings are based on interview data collected at 22 Dutch architectural firms and show that the resources which are necessary for value creation may either enhance or constrain the firm's value capture. This research contributes to construction management literature by providing a profound insight into the pitfalls and opportunities of real estate development by architectural firms. It helps architects to improve their business models in order to enable organizational sustainability.

Keywords: business model, value capture, value creation, value proposition

INTRODUCTION

Architectural firms increasingly take on new or altered roles to respond to ongoing societal and industry-level changes (Duffy and Rabeneck 2013). Their new ways of service delivery have to be accompanied by business models that are designed to serve and satisfy customers and to run a successful business at the same time. So far, little is known about the different business models that architectural firms employ and how these work out under certain market conditions or for certain types of firms. To successfully compete in a highly dynamic business environment, firms need to know how they can sustain or renew their competitive advantage (Teece 2010). Hence, a better understanding of the strengths and weaknesses of their business models is crucial.

Business model theory distinguishes between the value proposition, value creation and value capture of firms (Clauss 2016). The three interrelated constructs provide a powerful analytic outline to study how the business model of architectural firms is configured and how it is influenced by the challenges that firms face (Maister 2012, Winch and Schneider 1993). Business models for architectural service delivery need to incorporate the duality of practice and business (Coxe *et al*., 2005).

In this research, we aim to develop knowledge of the business model for real estate development by architectural firms. We used a theoretical framework, based on business model theory from the field of management and literature on creative

[1] m.bos-devos@tudelft.nl

Bos-de Vos, M, Volker, L and Wamelink, H (2016) Real Estate Development By Architectural Firms: Is The Business Model Future-Proof? *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference,* 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1049-1058.

professional service firms, to analyse interview data gathered from representatives of 22 Dutch architectural firms. We discuss how resources enable or constrain the value creation and value capture of architectural firms from the offer of a real estate development value proposition. We contribute to literature by providing insight into the specific constraints and possibilities of real estate development business models for architectural firms. This insight may help architects to develop business models that are future-proof from both a professional and a business perspective.

THEORETICAL BACKGROUND

Business models

Over the last decennia, business models have become an important area of interest in different research fields and the potential of the business model concept for both the academic world and industry has been widely acknowledged (Clauss 2016).

Although scholars define the business model differently, they seem to agree that value is at its core. Shafer *et al*., (2005, 202), for example, define a business model as "a representation of a firm's underlying core logic and strategic choices for creating and capturing value within a value network". Zott and Amit (2010, 216) conceptualize the business model as "a system of interdependent activities that transcends the focal firm and spans its boundaries". They too refer to value, as "the activity system enables the firm, in concert with its partners, to create value and also to appropriate a share of that value" (ibid.). Osterwalder and Pigneur (2010: 14) helpfully include the pivotal role of value in their definition: "A business model describes the rationale of how an organization creates, delivers, and captures value".

Many scholars conceptualize the business model as a configuration of different subconstructs (Clauss 2016), which are, for example, referred to as building blocks (Osterwalder and Pigneur 2010), components (Shafer *et al*., 2005), elements (Teece 2010) or dimensions (Baden-Fuller and Mangematin 2013). From his literature review, Clauss (2016) recognizes three main dimensions that explain a firm's business model, namely value proposition, value creation and value capture. The value proposition is aimed at solving customer problems and satisfying customer needs (Osterwalder and Pigneur 2010). It contains the solutions for customers and how they are offered (Clauss 2016). Value creation refers to how and by what means firms create value along the value chain (ibid.). It includes any activity that provides benefits that the customer is willing to pay for (Lepak *et al*., 2007). Finally, value capture explains how value propositions are converted into revenues (Clauss 2016). It revolves around the firm's revenue model and cost structure. A revenue model that is able to outweigh the firm's costs is key to organizational sustainability (Bowman and Ambrosini 2000).

Building on the three main dimensions of the business model as identified by Clauss (2016) and expanding on the definition given by Osterwalder and Pigneur (2010), we define the business model as the rationale of how an organization proposes, creates, and captures value.

Out of the array of aspects that play a role in a firm's business model (see for example the overview of literature by Zott *et al*., (2011) and Clauss (2016)), firm resources seem particularly important. According to the 'resource-based view', resources represent a firm's primary source of competitive advantage and thus define its ability to create and capture value. Resources are the tangible or intangible assets that are tied semi-permanently to a firm, such as physical, human or organizational capital (Barney

1991). Capabilities are firm-specific, organizationally embedded resources, or 'intermediate goods' that are built by a firm to handle its combined resources in order to achieve a desired goal (Makadok 2001). Scholars who follow the 'dynamic capabilities view' consider this specific type of resource crucial to successful value creation and value capture over time as capabilities enable the firm to adapt to its environment (Achtenhagen *et al*., 2013).

Business models for architectural firms

Architectural firms are professional service firms (PSFs), a specific category of knowledge-intensive firms that are hired by their clients for their expertise and skills to work on unique problems (Von Nordenflycht 2010). As PSFs face both commercial and professional goals (Maister 2012), their value proposition, value creation and value capture extends beyond the traditional business interaction of perceived customer value and fee (Bowman and Ambrosini 2000). It also involves professional value, such as reputation, development or work pleasure (Bos-de Vos *et al*., 2016).

PSFs often work in project-based constellations to perform their complex, customized work (Jones *et al*. 1998). The interaction with other stakeholders helps firms to deal with the heterogeneity and uncertainty that is involved in their work (Boyd and Danks 2000). Business model research of project businesses has only recently started to develop (Wikström *et al*., 2010). Kujala *et al*., (2010) support the view that a firm can have multiple business models and argue that the business model analysis in project-based firms needs to take place at the project-level rather than at the firm-level.

Figure 1 presents a business model framework for architectural service delivery based on our review of the literature. The framework is related to a project instead of to an entire firm and is useful to study the firm's value proposition, value creation and value capture in the respective project. The value proposition refers to what the firm offers the customer in anticipation of the customer's needs or desires. We distinguish between process services and product services.

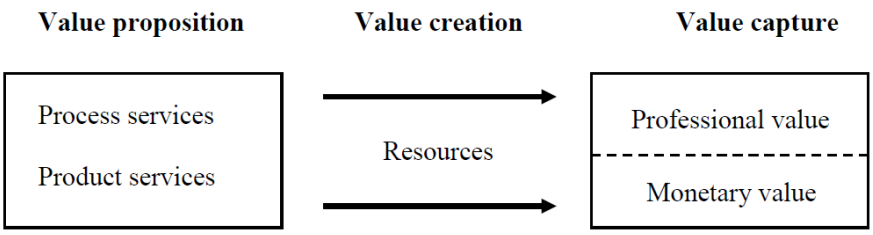


Figure 1: Business model framework for project of architectural firm

Value creation refers to how the firm creates value for the customer (and possibly also other stakeholders) based on the services that are proposed. We include the firm's resources as an important mean for value creation. Resources also influence the amount of value that the firm is actually able to capture. They are key determinants of firm performance (Makadok 2001). Our framework expands on the classic definition of value capture, which we refer to as monetary value capture (i.e. firm revenues and profits) and includes professional value as a second dimension of value that can be appropriated by architectural firms. Professional value includes all the non-monetary elements that are important for the firm's existence and survival (e.g. reputation, development, work pleasure) (Bos-de Vos *et al*., 2016).

RESEARCH APPROACH AND METHODS

We used a qualitative research approach to expand on the information available in literature and to develop a profound understanding of business models for architectural service delivery (Miles and Huberman 1994). From January 2014 until January 2015, we conducted 28 face-to-face interviews with representatives of 22 Dutch architectural firms. We chose to use a semi-structured interview protocol. In this way, we were able to address different topics from literature while leaving room for the respondents to come up with additional themes. The interviews lasted between one and two hours. They were all audiotaped and transcribed verbatim. This resulted in 821 pages of interview data. The transcripts were checked by the respondents and their comments were implemented. We gathered additional firm-related and project-related material from the respondents, the firms' webpages and the business press to reinforce or question the interview findings.

The aim for the interview sample was to cover the wide range of architectural services that are provided by Dutch architectural firms. We searched for firms with different age, size and technology policies (Mintzberg 1979). The 22 firms that we selected were, at the time of the interview, between 1 and 87 years old, consisted of between 3 and 120 people (Vogels 2015), and used either 2D drawing or 3D modelling technologies. The firms had a design-oriented or service-oriented strategy (Coxe *et al*., 2005) and were located in different geographic areas of the Netherlands.

The semi-structured interview protocol included questions to address the theoretical constructs 'value proposition', 'value creation' and 'value capture'. Regarding value proposition, respondents were questioned about what services and products they offered, why specifically these services or products were chosen and if they expected their value propositions to change in the near future. The questions about value creation and value capture were related to specific projects. Regarding value creation, we asked the interviewees which competences, resources or partnerships the firm used to create value for the client and user, how these influenced the value that was created in the project and what was missing to create value. Regarding value capture, respondents answered questions about the outcome of their service delivery in terms of monetary and professional value.

We systematically analysed the interview data with the help of our framework, which we further developed while going back and forth between literature and empirical data. Software program MAXQDA was used as a supporting tool for the data analysis. Our data analysis procedure consisted of four steps. First, we derived value propositions from the data, which we divided into overarching categories. Second, we looked into the value creation of the different projects that were mentioned and searched for the resources that particularly enabled or constrained the architectural firm's value creation in the project. Third, we focused on the firm's value capture and analysed how resources influenced the appropriation of professional and monetary value in the project. Finally, we searched for similarities and differences across the projects to build theory. In this fourth step, we identified common opportunities and pitfalls for different scenarios of service delivery, which we supported with examples from multiple cases. In this paper, we discuss the business model for the delivery of real estate development services. Other business models will be included in a next paper.

FINDINGS

The value proposition: Offering real estate development services

Architectural firms that wish to deliver real estate development services appear to choose either a 'product development' or a 'business case development' value proposition. The 'product development' value proposition refers to the product-oriented services that are offered to come up with a design and the more process-oriented services that are needed to actually realize the designed product. According to the data, the main goal for architects is to ensure a substantial role for the architectural firm within the project. Firms, for example, proposed new apartment buildings to potential buyers. Respondents believed that selling the design of buildings directly to the end-users would naturally exclude the interference of other actors and lead to a bigger role for the architectural firm. One of the firm owners described his firm's value proposition as the design of "affordable but special dwellings" in which the buyer, who is also the end-user, becomes directly involved in the design process and is able to influence the design of his own house, something that is only possible to a very limited extent in regular housing projects in the Netherlands. Another example of the 'product development' value proposition is the offer to design and realize the transformation of existing buildings.

The 'business case development' proposition consists of the services that are necessary to design and realize a marketable product, which has its own revenue stream. Architects used this kind of value proposition to demonstrate that they are able to add value to society by upgrading parts of the city in unexpected ways. An exemplary project that was based on this kind of value proposition consisted of the profitable and attractive transformation of an existing office-building that was on the list to be demolished. By setting up a profitable business plan for this project, the architectural firm wanted to show both the potential of the property and the added value of an architectural approach. Based on this and other examples, we found that a 'business case development' proposition helped architects not only to generate societal value, but also monetary value for the property owners.

The value creation: Delivering real estate development services

As our data shows, architectural firms are particularly depended on financial knowledge to create value with a 'product development' or 'business case development' type of proposition. It seems that financial knowledge is crucial to study the feasibility of a certain location and product idea, which are both key elements in real estate development. One of the firm owners emphasized the importance of knowledge about property calculations and investment calculations. He either asked employees who were specialized in calculating to expand on their regular work by including earlier stage calculations or attracted partner firms when it got really specific. Financial knowledge also seems crucial to develop a well-thought-through business case that allows a project to generate its own revenues. This was illustrated, for example, by the transformation project. In this project, the architectural firm gained the necessary financial knowledge by collaborating with a young real estate developer. Together they came up with a business case with a return of investment after five years by means of rental incomes.

Architectural firms typically do not own land, properties or substantial financial resources. We found that this lack of physical resources motivates architects to look for capital-intensive partners in their development projects, such as financers,

developing contractors or developers. One of the firms that wanted to realize a new apartment building, for example, used its connections with the local municipality to find vacant and suitable plots for a project. Another firm initiated partnerships with a developer and a developing contractor as these actors had both access to financial resources and ownership of land. We found that architectural firms also collaborate with other architects to share their knowledge. As indicated by one of the respondents, a partnership between multiple architectural firms may even present an opportunity to avoid the involvement of a capital-intensive partner.

The real estate development activities by architectural firms are initiated 'bottom-up' and do not fit into the standard regulatory frameworks. Therefore, the support of influential actors appears to be necessary to create value. Dutch architectural firms seem particularly looking for the facilitation by municipalities. Many of our respondents mentioned that municipalities had to become more 'guiding' to facilitate the real estate development initiatives of smaller organizations such as architectural firms. They criticized municipalities for being mainly interested in deals with bigger organizations. We found that the involvement of influential actors such as municipalities helps to create a large support base for a project. One firm, for example, was better able to get its projects realized once they had managed to become a strategic partner of the municipality.

The value capture: Outcomes of real estate development services

Data show that financial knowledge helps architectural firms to generate monetary value from their service delivery. Examples of both a 'product development' and 'business case development' type of value proposition indicate that financial knowledge is employed by architectural firms to determine viable or profitable fees. In a 'business case development' proposition, financial knowledge also enables firms to generate income or save costs from the revenue stream that is created in the project. The firm of the transformation case, for example, cleverly saved on its monthly costs by renting the property that they developed for only a reimbursement of expenses.

Our data point out that successful professional value capture from the delivery of real estate development services is only possible when architects enjoy the large amount of managerial and financial activities that are needed. Architects who do not have any affinity with these kinds of activities risk losing their work pleasure, an important part of professional value capture. One of the architects, for example, stated that she absolutely did not want to do a similar project a second time. During the project, she had to be everything at the same time: the developer, the facility manager and the architect. It generated huge amounts of stress and in the end she wondered for who she had been doing it. In the future, she and her partner just wanted to focus on the core of their business: "the design thinking". This shows that a professional drive to be involved in managerial and finance-oriented activities is key to the real estate development business model and absolutely necessary for firms who offer 'product development' or 'business case development' propositions.

The interviews show that the monetary value capture of architectural firms is severely hindered by the involvement of capital-intensive partners. For instance, the developer that provided access to land and capital in the case of an apartment building was unwilling to pay for the lead architect's hourly rate of 150 euros. According to the architect, the developer considered him 'an artist' and the hourly rate inappropriate.

Although the architect stated that the rate was both reasonable and necessary because he had created an entire business plan for the project, he was struggling to convince

the developer of this added value. The example of the transformation project shows that although projects are indeed able to generate money, it is incredibly difficult for architectural firms to appropriate a share of that money. A different investor took over the project as he recognized the money stream that was involved. The architects, who were planning on generating revenues with their business case after five years, where suddenly no longer a party of interest in the project. They even did not receive any monetary compensation for their idea and extensive service delivery.

Based on the interviews, we suspect that the difficulty of monetary value capture is complicated even further by the importance of professional value capture. We found evidence that although architects acknowledge the importance of generating revenues with their projects, they considered making a statement as an architect and a societal impact more important than making money. One architect, for example, said: “We primarily wanted to prove that this can grow, so we actually proved what we wanted to prove”. It seems likely that this strong professional drive prevents firms from making clear business agreements in their partnerships, which can take its toll when an unexpected actor enters the arena.

A relationship with the buyer appears to help architectural firms to capture both monetary and professional value. Regarding monetary value capture, a personal relationship with the buyer or with an influential person in the 'buying' organization is beneficial to the fee negotiation of architectural firms as it helps firms to explain their added value to the client. In one of the cases, for example, the architect was able to negotiate a fee that would ensure a reasonable income and profit margin because he was in direct contact with the director of a small family-run contracting company.

Another case shows how an architect-buyer relationship provides architectural firms bargaining power for the fee negotiation when a capital provider is involved. “Meanwhile I [the architect] just think: ‘you need me’. I have a database of twelve hundred people of which two hundred […] literally want one of our homes, thirty or forty of them would like to sign tomorrow”. This architect's personal relationship with many potential buyers gave him an opportunity to negotiate a higher fee from his capital investor. Regarding professional value capture, a relationship with the buyer seems an important condition for the work pleasure of architects. One of the architects, for example, said that for him it was more about the buyers than about the money: “New people every week, who are all in love with your project. What more do you want? That’s just incredibly cool, isn’t it?”

CONCLUDING DISCUSSION

This paper contributes to the theory development of business models for architectural service delivery. It specifically adds to construction management literature by highlighting the pitfalls and opportunities of business models for architectural firms that are offering and delivering real estate development services. We show how resources that are crucial for value creation can also complicate the monetary or professional value capture of architectural firms.

Our business model analysis, which is based on a framework that distinguishes between the value proposition, value creation, and value capture (professional value and monetary value) of architectural firms within a project, demonstrates the importance of four resources in the real estate development by architectural firms, namely financial knowledge, capital-intensive partners, support of influential actors and a relationship with the buyer.

First, we show how financial knowledge helps architectural firms to turn to negotiate profitable fees and to come up with profitable business cases for projects. The interviews provide evidence that the deployment of this knowledge really needs to fit the firm. To ensure work pleasure and thus professional value capture, architects need to feel happy with a more financially-oriented way of working.

Second, we point out that capital-intensive partners are crucial to create value as they provide access to land/property and capital. However, the involvement of such partners also seriously hampers the monetary value capture of architectural firms. This suggests that architectural firms need both a strong financial drive and a high level of persuasiveness to ensure that partnerships with these kinds of actors are profitable to the firm. We suspect that firms will especially benefit from capital-intensive partners that are willing to support the architect's goals. Some actors outside the construction industry may fit this requirement surprisingly well.

Third, the support of influential actors, such as municipalities, is necessary to facilitate the real estate development by architectural firms. Strategic partnerships with these kinds of actors may be extremely helpful. We expect that the inclusion of added value for influential actors in the value propositions of architectural firms may lead to mutually productive partnerships and ease real estate development by architectural firms.

Finally, we found that a relationship with the buyer - which is not really necessary to create value - is very important for the architectural firms' value capture. It increases the firm's bargaining power to negotiate a fee and ensures work pleasure and thus professional value capture. These insights suggest that firms should be extra cautious to engage in service delivery without the involvement of a buyer, as it is not likely to result in any benefits for the firm. Moreover, a project in which the buyer is a large organization seems to involve a higher level of risk regarding the firm's value capture. Firms need to assess these risks and take appropriate measures.

Although our data show that business models for real estate development services by architectural firms are not yet profitable or completely satisfactory, we found some major strengths and weaknesses of these particular business models. Building on our findings, this study offers architectural firms knowledge to implement or improve business models for real estate development services and to consequently enhance future financial and professional performance.

ACKNOWLEDGEMENTS

This study is part of futurA, an ongoing research project on new governance and business models for architectural services (www.future-architect.nl) financed by the Netherlands Organisation for Scientific Research (NWO) and a consortium of industry partners.

REFERENCES

Achtenhagen, L, Melin, L and Naldi, L (2013) Dynamics of business models: strategizing, critical capabilities and activities for sustained value creation. *Long Range Planning*, **46**(6), 427-442.

Baden-Fuller, C and Mangematin, V (2013) Business models: A challenging agenda. *Strategic Organization*, **11**(4), 418-427.

Barney, J (1991) Firm resources and sustained competitive advantage. *Journal of Management*, **17**(1), 99-120.

Bos-de Vos, M, Wamelink, J H and Volker, L (2016) Trade-offs in the value capture of architectural firms: The significance of professional value. *Construction Management and Economics*, **34**(1), 21-34.

Bowman, C and Ambrosini, V (2000) Value creation versus value capture: Towards a coherent definition of value in strategy. *British Journal of Management*, **11**(1), 1-15

Boyd, D and Danks, S (2000) An analysis of 'the architectural practice' in the construction industry. *In*: A Akintoye (Ed.) *Proceedings 16th Annual ARCOM Conference*, 6-8 September 2000, Glasgow, UK. Association of Researchers in Construction Management, Vol. 2, 693-702.

Clauss, T (2016) Measured business model innovation: Conceptualization, scale development and proof of performance. *R&D Management*, [Early View doi: 10.1111/radm.12186]

Coxe, W, Hartung, N F, Hochberg, H H, Lewis, B J, Maister, D H, Mattox, R F and Piven, P A (2005) *Charting your course, Master Strategies for Organizing and Managing Architecture Firms*. Available from http://davidmaister.com/wp-content/themes/davidmaister/pdf/ChartingYourcourse750.pdf [Accessed on 6th January 2009]

Duffy, F and Rabeneck, A (2013) Professionalism and architects in the 21st century. *Building Research and Information*, **41**(1), 115-122.

Jones, C, Hesterly, W S, Fladmoe-Lindquist, K and Borgatti, S P (1998) Professional service constellations: How strategies and capabilities influence collaborative stability and change. *Organization Science*, **9**(3), 396-410.

Kujala, S, Artto, K, Aaltonen, P and Turkulainen, V (2010) Business models in project-based firms: Towards a typology of solution-specific business models. *International Journal of Project Management*, **28**(2), 96-106.

Lepak, D P, Smith, K G and Taylor, M S (2007) Value creation and value capture: A multilevel perspective. *Academy of Management Review*, **32**(1), 180-194.

Maister, D H (2012) *Managing the Professional Service Firm*. New York: Simon and Schuster.

Makadok, R (2001) Toward a synthesis of the resource-based and dynamic-capability views of rent creation. *Strategic Management Journal*, **22**(5), 387-401.

Miles, M B and Huberman, A M (1994) *Qualitative Data Analysis: An Expanded Sourcebook*. Thousand Oaks, CA: Sage Publications.

Mintzberg, H (1979) *The structuring of organizations: A synthesis of the research*. University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership, Historical Research Reference in Entrepreneurship.

Osterwalder, A and Pigneur, Y (2010) Business model generation: A handbook for visionaries, game changers and challengers. Hoboken, NJ: John Wiley and Sons.

Shafer, S M, Smith, H J and Linder, J C (2005) The power of business models. *Business Horizons*, **48**(3), 199-207;

Teece, D J (2010) Business models, business strategy and innovation. *Long Range Planning*, **43**(2–3), 172-194.

Vogels, R (2015) *BNA Benchmark 2015, Resultaten Boekjaar 2014* (BNA Benchmark 2015, Results Financial Year 2014). Zoetermeer: Panteia.

Von Nordenflycht, A (2010) What is a professional service firm? Toward a theory and taxonomy of knowledge-intensive firms. *Academy of Management Review*, **35**(1), 155-174.

Wikström, K, Artto, K, Kujala, J and Söderlund, J (2010) Business models in project business. *International Journal of Project Management*, **28**(8), 832-841

Winch, G and Schneider, E, (1993) The strategic management of architectural practice. *Construction Management and Economics*, **11**(6), 467-473.

Zott, C and Amit, R (2010) Business model design: An activity system perspective. *Long Range Planning*, **43**(2-3), 216-226.

Zott, C, Amit, R and Massa, L (2011) The business model: Recent developments and future research. *Journal of Management*, **37**(4), 1019-1042.

VALUE CO-CREATION IN A PROJECT SETTING: A SERVICE-DOMINANT LOGIC PERSPECTIVE

Marcos Fuentes[1] and Hedley Smyth

Bartlett School of Construction and Project Management, University College London, 2nd Floor, 1-19 Torrington Place, London, WC1E 6BT, UK

Research is needed to understand how value co-creation could improve project outcomes and benefits. Many studies have shown projects do not meet mandatory objectives. Further, few projects configure and design value propositions to deliver a service experience and value beyond the minimum requirements. A solution to these problems may lie in a shift on projects: from production to a service focus. Service-Dominant Logic (yet a contested arena) has become a paradigm in the marketing and is providing influence in management studies. It offers a fresh perspective to see projects as a service with a focus on outcomes. It also provides an alternative standpoint to analyse the benefits delivery and effectiveness for the long-term: value-in-use and context. However, Service-Dominant Logic needs to be operationalised as it might not work in isolation. Service Design could be used to make a bridge between practice and theory. Contrary to Service-Dominant Logic, Service Design is rooted in practical applications and could mobilise a service logic. This paper contributes to the research community by exploring the link among value co-creation, service-dominant logic and service design in the project context.

Keywords: service design, service-dominant logic, value co-creation

INTRODUCTION

Product centricity has, to some extent, dominated both past and modern forms of exchange in the project business. Yet, projects have extended periods of exchange with a service value-in-use and benefits post completion in operational use that may go beyond the client and end-user. Moving towards a service logic is not straightforward process as it requires a substantial re-organisation of any business (Leiringer and Bröchner 2010). A fundamental concept within a service logic is value co-creation which has implications in both execution and the operations phase. Value could be considered as a unique benefit and is enabled, in different contexts (places and times), during usage (Vargo and Lusch 2016). In that vein, value co-creation could be defined as a joint and unique process to improve both the condition of actors (Grönroos 2011) and the project outcome as an ultimate goal. Caution should be taken with value co-creation: if it is not properly managed, it could lead to co-destruction (Echeverri and Skålén 2011). The concept of value co-creation is still in its infancy (Ostrom *et al*., 2015) but could be regarded as the next practice in project business (Smyth 2015). The notions of value are not new. For instance, Value Management, driven by workshops, is focused on the improvement of the system functionality but with a strong inclination on achieving a cost reduction in practice.

[1]marcos.fuentes.14@ucl.ac.uk

Fuentes, M and Smyth, H (2016) Value Co-Creation in a Project Setting: A Service-Dominant Logic Perspective. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1059-1068.

Service-Dominant Logic (SDL), from the marketing school of value, goes beyond that. It provides an alternative standpoint to analyse the benefits delivery and effectiveness for the long-term: value-in-use and context (Vargo and Lusch 2016). However, SDL presents contradictions and some of its principles might not work in the projects (Hartmann *et al*., 2014). Much of the SDL research is around high volume products/services, contrary to projects where uniqueness is a major characteristic. Therefore, further research is needed in order to bring together the concepts of value co-creation and the increasingly prevalent notion of SDL into projects (Smyth *et al*., forthcoming 2017).

This paper argues that co-creation of value needs to be managed before the service is in use (contrary to current trends in the marketing literature). Also, that value co-creation reaches its peak intensity in the design phase of a service (through co-design) with implications in subsequent phases of a project. The main objectives of this paper are to illustrate: (1) a critical review of SDL; (2) the connection between SDL and Service Design (SD); (3) a mini case to exemplify how SDL could be used as a theoretical lens to examine projects and value realisation. In the next section, previous research on service(s) is briefly introduced. This section lays the basis for the demonstration of SDL/SD. Finally, a summary and implications for the construction are provided.

Background in service(S) research

Construction projects can be considered as a service to offer value through the application of socially constructed resources (knowledge and skills), which represent the main source of strategic benefit (Vargo and Lusch 2004). Bröchner (2010) argues that construction presents some alignment with service industries. However, it is largely producing a “good” for exchange and is manufacturing oriented (Bettencourt *et al*., 2014), in which value comes from inputs within the firm and its supply chain. Exceptions exist e.g. Build–Operate–Transfer type projects, where services are supplied, such as finance and facilities management.

Although SDL has recently appeared, a service logic previously termed 'servitization' encouraged manufacturing firms to add value through the delivery of services (Vandermerwe and Rada 1988). Recent research shows that contradictions and struggles of organising arise in servitisation (Chan *et al*., 2015). Successful examples provided by large organisations, e.g. IBM and GE, might entice project organisations towards this logic. Yet, organisations struggle to improve their competitive advantage (Neely 2008; Gebauer *et al*., 2011). Additionally power inequalities, conflicts and fragility of long-term relationships need careful consideration (Alderman and Ivory 2007). Artto *et al*., (2008) point out that some organisations prefer to stay upstream from the delivery of the project due to the demanding impacts that this logic may invoke. In general, an organisation willing to innovate and move up the value chain, e.g. high-value integrated solutions (Davies and Hobday 2005), does so slowly because new capabilities need to be developed under new business models (Wikström *et al*., 2009). Schmenner (2009) pointed out that the move to servitisation has been led by organisations with limited manufacturing strength. For instance, IT organisations have found this easier, e.g. via the 'Software-as-a-Service' delivery model where the software is centrally hosted in the cloud but the hardware is not being acquired by the client (nevertheless, the hardware is still part of the solution but not on premise). This kind of example is given as it has led to a common misunderstanding in the service logic: it does not preclude a focus on 'goods' but

considers an integration of products and service(s) with an eye on the project outcome (Lusch and Vargo 2014).

A focus on the outcome/value could be obvious. Yet the client is usually inclined to focus short term on the financial part of the equation: value-for-money. This can result in poor value/benefits to stakeholders. As widely known, traditional project management methodologies (e.g. PMBOK from PMI or Prince2) are largely limited to project inputs around time-cost-quality/scope with the assumption that this leads to financially successful and/or appreciated outcomes (impact and benefits delivery) (Morris 2013). Thus, fresh solutions are needed to raise value propositions. Chesbrough (2011) points out that not only the client but also other actors in the service ecosystem are able to co-create innovative service offerings. Marketing (with SDL) at that particular point plays a pivotal role on how to jointly develop projects in order to ensure dense value propositions (Smyth 2015).

A Review of Service-Dominant Logic (SDL)

The SDL perspective reaches back into political economy to use value (Vargo and Lusch 2004). It is an alternative lens to the economic and social exchange of human's activities. SDL may fit at a societal level (Edvardsson *et al*., 2011) but may not work at a micro level (Grönroos 2011). Service is defined as "the application of competencies (knowledge and skills) for the benefit of another entity or the entity itself" (Lusch and Vargo 2014:12). That is, socially constructed resources (operant resources) such as skills, knowledge and technology (e.g. BIM) are able to provide a strategic benefit to organisations. Those kind of resources are used to manage production (operand resources) and shared institutional logics e.g. conflicts.

In SDL, suppliers work with, rather than for, the client and other multiple of actors in the service ecosystem e.g. partners, competitors, the environment, and other societal stakeholders (Akaka *et al*., 2013). The premises of SDL (Vargo and Lusch 2016) have been part of scholarly development with roots in co-production, agile production, co-creation experiences, value constellations and others (cf. Norman and Ramirez 1993, Prahalad and Ramaswamy 2004). SDL has however integrated such development (Grönroos 2011) and it is now claimed that SDL may offer superior value (Karpen *et al*., 2012). In contrast, SDL has been sharply criticised and problematised e.g., Service Logic (Grönroos 2011); Value-in-the-Experience (Helkkula *et al*., 2012); Customer-Dominant Logic (Heinonen *et al*., 2015). For instance, the latter redefines the focus of value-in-use to be in the customer sphere. However, giving all the value-in-use to the customer might not be reflected in value-in-exchange to the supply organisations (e.g. rents in the housing sector).

SDL is not the panacea and its misunderstandings could lead to "fatal management decisions and actions" (Grönroos 2011:288) due to the misuse of its pivotal concept: value co-creation (Grönroos 2011). Analytical concepts rather than metaphorical and normative prescription should be developed to support operationalisation (Wright and Russell 2012). The value co-creation process has been further developed (Payne *et al* ., 2008) yet remains unclear, e.g. dis-benefits of co-creation of value (Echeverri and Skålén 2011); start and finish point (Grönroos 2011); Return-on-Marketing-Investment (Smyth 2015); reasons for co-participation (Nambisan and Baron 2009); unknown role of the customer and supplier in co-creation in use (Grönroos 2011). In fact, some roles (e.g. end-user; client) can be interchangeable, complicating examination of the exchange for Business-to-Business (B2B) relationships. SDL with the Actor-to-Actor approach (A2A) claims to break free of the previous and simplistic

institutional logics. However, actors must be clearly identified (Grönroos 2011) rather than being treated equally, as SDL theory largely initially did, although the institutional dimension has been reintroduced recently (Vargo and Lusch 2016).

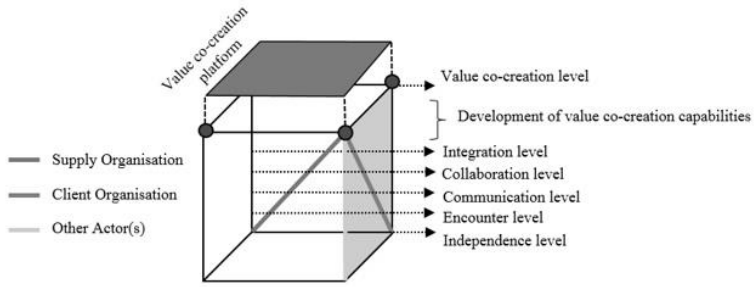


Figure 1: The value co-creation path in the project context (Source: Adapted and developed from Hudson et al., 1998).

SDL requires further development to be considered in the project business. Little empirical SDL research has been developed in projects (Cova and Salle 2008, Liu *et al*., 2014, Razmdoost and Smyth 2015); others narrowly applied (Xu *et al*., 2013). This paper argues that before a project organisation reaches a value-driven approach, it should pass through a collaboration level (Smyth and Pryke 2009) and integration level (Davies *et al*., 2005) (see Figure 1). Once reached, a platform of value co-creation, where actors can engage and co-create over time, can be established. For example, Apple has successfully used this platform where other organisations can add new systems, apps, music on top of its service offering (Chesbrough 2011). Other successful examples of co-creation exist (in Aviation, IT, Music and Entertainment), resulting in financial and non-financial benefits (Chesbrough 2011). Thus, some principles could be applied to construction. The construction sector at that point has underperformed. Generic co-creation capabilities (see Table 1) need to be developed from portfolio to programme level, partially tailored at the front-end (from programme to project level) and nuanced tailoring during delivery (project execution).

For operationalisation in a project level, SDL could take a shift from routines to unique activities where some resources are not given and novel activities, under a value imagination approach (Razmdoost and Smyth 2015), backcasting for service design (Smyth, 2015) through a holistic approach (Patrício *et al*., 2011) to become a force that modifies existing routines and creates pre-conditions for others. On the other hand, routines, in contemporary literature (Feldman and Pentland 2003), are not considered as mundane repetitions but as a source of flexibility and change in which intense and effort-laden accomplishments, such as co-creation, can also take place (Robinson and Chan 2014). Yet, a guideline of steps to undertake a value co-creation process has not yet been formulated (Ostrom *et al*., 2015). Tronvoll *et al*., (2011) suggest that SDL needs mixing with other disciplines to capture the dynamics of a service. Service Design (SD) could be used to make a bridge between practice and theory. Contrary to SDL, SD is rooted in practical applications and could operationalise SDL (Wetter-Edman *et al*., 2014). Therefore the connection between SD/SDL is worth investigating further.

Table 1: Value co-creation capabilities (Source: Developed and adapted from Karpen et al., 2012 influence by Davies and Hobday 2005; Smyth, 2015 in the project context)

Generic Co-creation Capability	Comments
Individuated Interaction Capability	Process to solicit knowledge and understanding as to what client want at a generic level with flexibility to tailor the services and customise the content to maximise the potential for value co-creation.
Relational Interaction Capability	Ability to respond to client and stakeholder wishes in the design process supported by proactive relationship management processes.
Ethical Interaction Capability	Application of a client orientated focus tempered by business acumen to satisfy corporate social responsibility and the moral economy.
Empowered Interaction Capability	Facilitating responsibility to teams and supporting actions and align processes in accordance with the requirements.
Developmental Interaction Capability	Developing programmes and codes of conduct to facilitate interaction and advise other parties of the primary associate protocols.
Concerted Interaction Capability	Synchronise processes and actions to be aligned with customer processes and protocols as part of the service design co-creation.
Learning Capability	To facilitate generation of competencies and to absorb lessons from the learning around the requirements for adaptive absorption and delivery.

Table 2: Integrated Co-Design for service (Developed and adapted from Patrício et al., 2011; Teixeira et al., 2012).

Levels of service co-design	Comments
I. Co-Design the service experience.	Mapping how actors integrate resources after the immediate service experience is essential.
II. Co-Design the service concept	The service concept starts from the inputs of the supply chain to and beyond the immediate service experience. An understanding of the business model used by the client organisation is vital.
III. Co-Design the static service system (architecture and engineering system)	This level considers aspects of the physical infrastructure.
IV. Co-Design the dynamic service system.	This level identifies how the actors will dynamically navigate across the infrastructure from execution to post-completion.
V. Co-Design the service encounter.	SDL expands the encounter beyond supplier-customer interaction and considers a service ecosystem including the market, the physical infrastructure, citizens and the environment.

The Mobilisation of SDL through Service Design

Design in construction could be better off if socially constructed resources are applied in early involvement (Volker 2008). This paper argues that value co-creation reaches its peak intensity in the design phase of a project. In fact, Sheth and Uslay (2007) say that the ramifications of value co-creation in co-design could play a fundamental role. SD could be considered an emerging discipline (Maffei *et al*., 2005) in which a wider design concept is introduced. It pays considerable attention to the experience and the product-in-use/context (Romme 2003). Kimbell (2011) defines design-for-service as an enquiry to understand the mobilisation across and beyond the value chain. This concept has the potential to give shape both to production, with aspects beyond buildability, and value realisation. Design issues still remain open, e.g. design teams (architects it is said in particular by practitioners) propose projects with poor buildability. Then, methods in which co-creation, through co-design, are needed to ensure value propositions are transferred from design to operations. Previous service design methods are able only to capture part a holistic service e.g. service blueprinting (Shostack 1984); servicescape (Bitner 1992). Significant integrative attempts are presented by Patrício *et al*., (2011) and Teixeira *et al*., (2012). The lessons from these attempts can be adapted for the project business, as proposed in Table 2: five levels of co-design could manage the value co-creation from the experience to the encounter. Nevertheless, further research is needed to unpack each of the levels of co-design to

understand which practices are being carried out at a project level. A mini case is given below to understand how SDL could be applied in projects.

A Mini Case to Illustrate Service-Dominant Logic

Higher education is a very dynamic sector in UK construction and provides the research focus for this mini case. In 2013–14 around 2.3 million students were enrolled in degrees. Academic and other staff, and students are all users. Therefore, project management offices on the client side are challenged to deliver benefits to a variety of stakeholders. A major UK university, as part of its development programme, carried out a refurbishment on a student residence in 2015. Interaction occurred between the client and main contractor during the procurement phase, but the project resulted in a poor outcome: a student strike for unbearable living conditions; £300,000 in compensation; confrontation between students and university staff; a ruined student experience; the reputation of the university damaged; delayed completion of the project due to a temporal suspension of the work. Why? The client organisation only approached the end-users during execution, curtailing learning opportunities about co-creation of value-in-use at the front-end of projects. The agency (students) could have been empowered for communicating potential value-in-use. This could have been captured at the front-end to inform the design and bidding, hence the value propositions. This would need management at the front-end to support interaction and dialogue between the actors both for and as part of co-creation. Under SDL lens, the client organisation plays the role of a mediator between the supplier and the end-users. Thus, this leads to intended and unintended co-creation of value in a triadic manner with a better integration. But traditionally, the end-user has been widely regarded as a destroyer (depreciation) of value (Vargo and Lusch 2016) and positioned at the end of the project chain (see Pryke and Smyth 2006:31). Previous studies of value co-creation are rooted in dyadic relationships between the client and supplier (Pinho *et al*., 2014). That view is limiting for B2B contexts, as shown above.

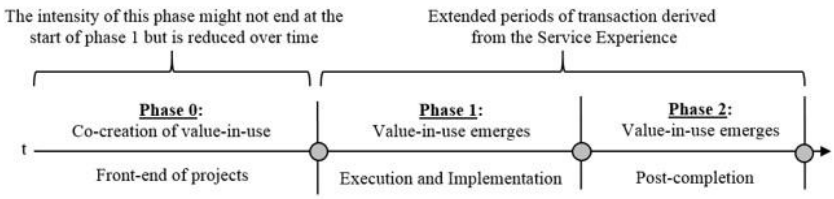


Figure 2: The value co-creation process in a project setting (Authors' own)

This example triggers the following assumption. Value-in-use has two phases for projects (see Figure 2): (1) value-in-use which emerges during the execution and delivery, and (2) value-in-use which emerges beyond completion. In that vein, extrapolating SDL theorisation would pose the proposition that consumption takes place before the completion of a project and it should be managed as part of the service experience. The focal point, located at phase 0, is schemed at improving the service experience and to co-creating the value-in-use. Building on Vargo and Lusch (2016) and Patrício *et al*., (2011), a framework for this mini case has been developed to systematically co-create value in a triadic relationship (see Figure 3). It could operationalise a service lens through an integrated co-design (see Table 2). In this model, the Design Team and the Contractor could work along with the Business Development Management and other functions (Smyth 2015) to co-create (co-design) the service offering. This framework may enable superior value/benefits to actors;

high-quality interactions; resource integration; holistic design; an innovative service offering. Apart from the SDL weakness previously discussed, other downsides are: (a) time-consuming to implement (e.g. identification of end-users/requirements); (b) investment through the development of capabilities with an eye on medium and long-term return (Smyth 2015); (c) a change of culture into a service logic with a focus on value (old habits may appear though); (d) careful attention should be paid when letting other actors join an independent process as it might create greater dis-benefits or even destroy the whole process (Echeverri and Skålén 2011).

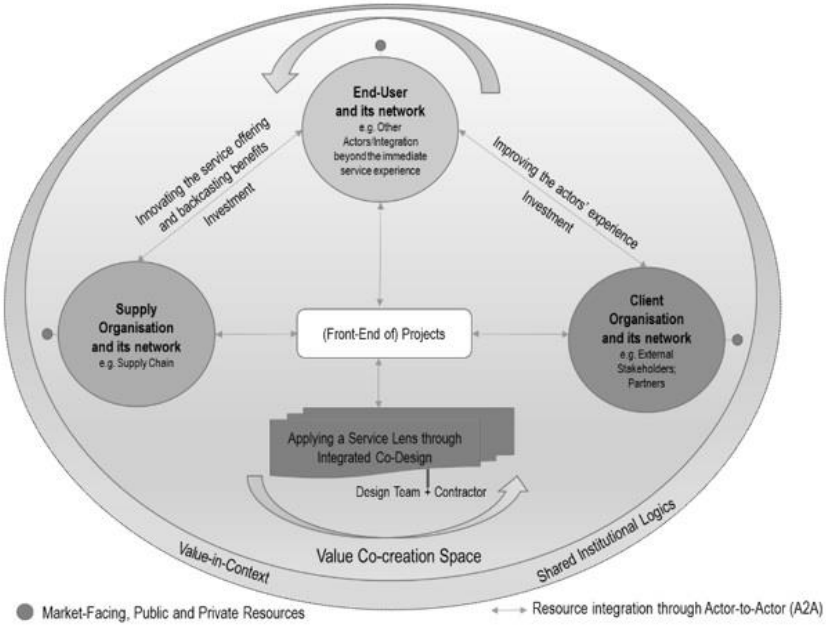


Figure 3: Value co-creation space in a project setting (Authors' own)

This framework could facilitate future empirical research to understand which SDL/SD practices are being carried out in the project business. Fair to say that SDL and/or this framework does not fit all the markets/projects but certainly, SDL could be applied to some markets, which are still rooted in the marketing mix or relationship approach. Other complex settings e.g. airports, require further investigation as heterogeneous actors (e.g. retailers, government, regulators, airlines, passengers, local community and suppliers) co-create value in a many-to-many approach rather than in a triad relationship.

CONCLUSIONS

An exploration of SDL in relation to projects has been put forward. SDL, although laden with contradictions and struggles, is a revolutionary framework which challenges neoclassical economics and offers fresh thinking that could improve project delivery and effectiveness for the value-in-use and context. If used in construction projects, SDL must be carefully adapted as exemplified. Additionally, caution should be taken with value co-creation as it might lead to undesirable outcomes. In summary, SDL, with the support of SD, has the potential to configure and design value propositions to deliver a service experience and value beyond the minimum requirements. There lies the challenge to operationalise SDL/SD in construction projects.

REFERENCES

Alderman, N and Ivory, C (2007) Partnering in major contracts: Paradox and metaphor. *International Journal of Project Management*, **25**(4), 386-393.

Artto, K A, Wikström, K, Hellström, M, and Kujala, J (2008) Impact of services on project business. *International Journal of Project Management*, **26**(5), 497-508.

Akaka, M A, Vargo, S L and Lusch, R F (2013) The complexity of context: A service ecosystems approach for international marketing. *Journal of Marketing Research*, **21**(4), 1-20.

Bettencourt, L A, Lusch, R F and Vargo, S L (2014) A service lens on value creation. *California Management Review*, **57**(1), 44-66.

Bitner, M J (1992) Servicescapes: The impact of physical surroundings on customers and employees. *The Journal of Marketing*, **56**, 57-71.

Bröchner, J (2010) Construction contractors as service innovators. *Building Research and Information*, **38**(3), 235-46.

Chan, P W, Robinson, W and Lau, T (2015) Material contradictions: Exploring paradoxes in Servitising construction. *In*: *Working Paper Proceedings, Engineering Project Organization Conference*, The University of Edinburgh, UK, June 24-26, 2015

Chesbrough, H W (2011) Bringing open innovation to services. *MIT Sloan Management Review*, **52**(2), 85.

Cova, B and Salle, R (2008) Marketing solutions in accordance with the SD logic: Co-creating value with customer network actors. *Industrial Marketing Management*, **37**(3), 270-277.

Davies, A and Hobday, M (2005) *The Business of Projects, Managing Innovation in Complex Products and Systems*. Cambridge: Cambridge University Press.

Echeverri, P and Skålén, P (2011) Co-creation and co-destruction: A practice-theory based study of interactive value formation. *Marketing Theory*, **11**(3), 351-373.

Edvardsson, B, Tronvoll, B and Gruber, T (2011) Expanding understanding of service exchange and value co-creation: A social construction approach. *Journal of the Academy of Marketing Science*, **39**(2), 327-339.

Feldman, M S and Pentland, B T (2003) Reconceptualizing organizational routines. *Administrative Science Quarterly*, **48**(1), 87-94.

Gebauer, H, Gustafsson, A, and Witell, L (2011) Competitive advantage through service differentiation by manufacturing companies. *Journal of Business Research*, **64**(12), 1270-1280.

Grönroos, C (2011) Value co-creation in service logic: A critical analysis. *Marketing theory*, **11**(3), 279-301.

Hartmann, A, Roehrich, J, Frederiksen, L and Davies, A (2014) Procuring complex performance, the transition process in public infrastructure. *International Journal of Operations and Production Management*, **34**(2), 174-194.

Heinonen, K and Strandvik, T (2015) Customer-dominant logic, foundations and implications. *Journal of Services Marketing*, **29**(6/7), 472-484.

Helkkula, A, Kelleher, C and Pihlström, M (2012) Characterizing value as an experience, implications for service researchers and managers. *Journal of Service Research*, January 10, 2012.

Hudson, B, Exworthy, M and Peckham, S (1998) *The Integration Of Localised And Collaborative Purchasing, A Review Of The Literature And Framework For Analysis*. University of Leeds/Institute for Health Policy Studies, University of Southampton.

Karpen, I O, Bove, L L and Lukas, B A (2011) Linking service-dominant logic and strategic business practice, A conceptual model of a service-dominant orientation. *Journal of Service Research*, **15**(1), 21-38.

Kimbell, L, (2011) Designing for service as one way of designing services. *International Journal of Design*, **5**(2), 41-52.

Leiringer, R and Bröchner, J (2010) Service-led construction projects. *Construction Management and Economics*, **28**(11), 1123-1129.

Liu, A M M, Fellows, R and Chan, I Y S (2014) Fostering value co-creation in construction, a case study of an airport project in India. *International Journal of Architecture, Engineering and Construction*, **3**(2), 120-130.

Lusch, R F and Vargo, S L (2014) *Service-Dominant Logic, Premises, Perspectives, Possibilities*. Cambridge: Cambridge University Press.

Maffei, S, Mager, B and Sangiorgi, D (2005) *Innovation Through Service Design: From Research And Theory To A Network Of Practice, A Users' Driven Perspective*. Joining Forces Conference, Helsinki, Finland, 21/09/05 - 23/09/05.

Morris, P W (2013) *Reconstructing Project Management*. Chichester, West Sussex: John Wiley and Sons.

Nambisan, S and Baron, R A (2009) Virtual customer environments, testing a model of voluntary participation in value co-creation activities. *Journal of Product Innovation Management*, **26**(4), 388-406.

Neely, A (2008) Exploring the financial consequences of the servitization of manufacturing. *Operations Management Research*, **1**(2), 103-118

Normann, R and Ramirez, R (1993) From value chain to value constellation. *Harvard Business Review*, **71**(4), 65-77.

Ostrom, A L, Parasuraman, A, Bowen, D E, Patrício, L, Voss, C A and Lemon, K (2015) Service research priorities in a rapidly changing context. *Journal of Service Research*, **18**(2), 127-159.

Patrício, L, Fisk, R P and Constantine, L (2011) Multilevel service design, from customer value constellation to service experience blueprinting. *Journal of Service Research*, **14**(2), 180-200.

Payne, A F, Storbacka, K and Frow, P (2008) Managing the co-creation of value. *Journal of the Academy Of Marketing Science*, **36**(1), 83-96.

Pinho, N, Beirão, G, Patrício, L and P Fisk, R (2014) Understanding value co-creation in complex services with many actors. *Journal of Service Management*, **25**(4), 470-493.

Prahalad, C K, and Ramaswamy, V (2004) Co-creation experiences, The next practice in value creation. *Journal of Interactive Marketing*, **18**(3), 5-14.

Pryke, S and Smyth, H (2006) Scoping a relationship approach to the management of complex projects in theory and practice. *In*: S Pryke and H Smyth (Eds.) *The Management of Complex Projects: A Relationship Approach*. Oxford: Blackwell Publishing, 21-45.

Razmdoost, K and Smyth, H (2015) *Value Co-Creation in Project Exchange*. 18th Academy of Marketing Science World Marketing Congress, Italy.

Robinson, W and Chan, P (2014) Servitisation in construction: Towards a focus on transitional routines. *In*: A Raiden and E Aboagye-Nimo (Eds.) *Proceedings 30th Annual ARCOM Conference, 1-3 September 2014, Portsmouth, UK*. Association of Researchers in Construction Management, 905-14.

Romme, A (2003) Making a difference, organization as design. *Organization Science*, **14**(5), 558-577.

Schmenner, R (2009) Manufacturing, service and their integration, some history and theory. *Journal of Operations and Production Management*, **29**(5), 431-441

Sheth, J, and Uslay, C (2007) Implications of the revised definition of marketing: From exchange to value creation. *Journal of Public Policy and Marketing*, **26**(2), 302-307.

Shostack, G (1984) Designing services that deliver. *Harvard Business Review*, **62**(1), 133-39.

Smyth, H and Pryke, S (2009) *Collaborative relationships in construction, developing frameworks and networks*. Chichester, West Sussex: John Wiley and Sons.

Smyth, H (2015) *Market Management and Project Business Development 1st Edition*. Abingdon: Routledge.

Smyth, H, Fellows, R, Liu A, and Tijhuis, W, (forthcoming 2017) Editorial for the special issue on business development and marketing. *Construction Management and Economics*, **34**(4-5), 205-217.

Teixeira, J, Patrício, L, Nunes, N J, Nóbrega, L, Fisk, R P and Constantine, L (2012) Customer experience modeling, from customer experience to service design. *Journal of Service Management*, **23**(3), 362-376.

Tronvoll, B, Brown, S W, Gremler, D D and Edvardsson, B (2011) Paradigms in service research. *Journal of Service Management*, **22**(5), 560-585.

Vandermerwe, S, and Rada, J (1988) Servitisation of business, Adding value by adding services. *European Management Journal*, **6**(4), 314-324.

Vargo, S L and Lusch, R F (2004) Evolving to a new dominant logic for marketing. *Journal of Marketing*, **68**, 1-17

Vargo, S L and Lusch, R F (2016) Institutions and axioms, an extension and update of service-dominant logic. *Journal of the Academy of Marketing Science*, **44**(1), 5-23.

Volker, L (2008) Early design management in architecture, partner selection and value judgement in design. *In*: S Pryke and H Smyth (Eds.) *Collaborative Relationships in Construction*. Oxford: Blackwell Publishing, 179-196.

Wikström, K, Hellström, M, Artto, K, Kujala, J and Kujala, S (2009) Services in project-based firms: Four types of business logic. *International Journal of Project Management*, **27** (2), 113-122.

Wetter-Edman, K, Sangiorgi, D, Edvardsson, B, Holmlid, S, Grönroos, C and Mattelmäki, T, (2014) Design for value co-creation, exploring synergies between design for service and service logic. *Service Science*, **6**(2), 106-121.

Wright, M and Russell, D (2012) Some philosophical problems for service-dominant logic in marketing. *Australasian Marketing Journal*, **20**(3), 218-223.

Xu, Y, Wang, D and Liu, C (2013) Applying service-dominant logic to construction project management. *In*: *Proceedings of the 2013 International Conference on Information System and Engineering Management*, IEEE Computer Society, Washington, 714-719.

THE BUSINESS DEVELOPMENT MANAGER AS A VALUE CREATION WORKER

Hedley Smyth[1]

Bartlett School of Construction and Project Management, University College London, 2nd Floor, 1-19 Torrington Place, London, WC1E 6BT, UK

The sales function, called business development management (BDM) in construction, is located at the front of the front-end of the project. The work of BDMs is twofold: to secure sales opportunities and to align client needs with firm capabilities through value propositions. The balance between the sales role and value related work depends upon the theoretical marketing lens applied. Applying the lens of the service-dominant logic (S-DL) implies that BDMs help to configure value propositions derived from their work in contacting and understanding of clients. This work is conceptually part of the co-creation of value and feeds into value realisation in two ways: (i) value in use and context as service provision during the project lifecycle, (ii) value in terms of benefits and impact post-completion. The empirical analysis examines the extent to which practice aligns with S-DL. Semi-structured interviews across 9 different contractors provide the source of information. Interpretative analysis is employed. The findings show a low level of awareness of the theoretical scope of the work among BDMs, a lack of support from senior managers and variable involvement at different stages of the project lifecycle. The theory-practice gap is broad and an evaluation of the appropriateness of the theory and practitioner work is provided as a conclusion. Future research can examine rates of BDM change, and practitioners can challenge current norms.

Keywords: Business Development Manager, Co-Creation of Value, Service-Dominant Logic, Project Lifecycle, Value Propositions

INTRODUCTION

Marketing in construction remains under-theorised. Marketing strategy is theoretically part of the corporate strategy and business model; yet, it is frequently divorced from other functions in practice (Pinto and Covin, 1992). Sales is part of marketing and the focus of this research is selling, particularly those responsible, who are called 'business development managers' (BDMs). Little is known about their activities, and hence, to understanding the construction firm and its operations. Investigating BDM conduct is set against the dual marketing aims of securing work and delivering value.

The service-dominant logic (S-DL) provides the marketing lens, placing particular emphasis upon value co-created in use and context (Vargo and Lusch, 2016), thus the formation of value propositions for delivery through mobilising, combining and integrating the resources of multiple actors. Why is this important? Value configuration is greatest at the project front-end, and business development, commencing prior to any particular project, is the first function to enter into the

[1] h.smyth@ucl.ac.uk

Smyth, H (2016) The Business Development Manager as a Value Creation Worker. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1069-1078.

project front-end. It is here that value is identified in and beyond the brief or stated requirements, before it is configured into value propositions during and with bid management. Value is then realised during delivery and post-completion (Smyth, 2015). The contribution of BDMs is overlooked in theory and practice.

Value creation is traditionally viewed as inputs for delivery. Yet, the S-DL definition adopted here sees value as co-created through combining organisational resources. Co-created value is realised in context and use (Vargo and Lusch, 2016). In projects, realisation is twofold: i) value is co-created during delivery and is experienced as a service; ii) the value of the project content is realised post-completion (Smyth, 2015). The ability and scope to co-create value informs the configuration of value propositions at the front-end during the sales and bidding stages. Configuring integrated value propositions can optimise value realisation in use and in context.

The research *aim* is to address the BDM contribution to value creation as a co-created activity via external and internal interactions. Previous research found low integration levels from marketing and sales into other functions (Smyth, 2015). The research objective is to see what BDMs do and evaluate this against functional support for forming value propositions. The research contribution is to examine the actions and behaviour of BDMs as value creation workers.

LITERATURE REVIEW

Value creation has a prime role in marketing (Woodruff, 1997). Haas *et al.*, (2012) state that value identification through sales has been neglected in marketing research. It has been neglected in construction. Theory suggests BDMs help identify and configure value at the front-end (Smyth, 2015). Yet, marketing lacks systematic implementation and linkage with other functions in construction (e.g. Preece *et al.*, 2003). The extent to which BDMs as workers are constrained or contribute to this finding is unclear. BDMs as value creation workers in construction have yet to be analysed in relation to the marketing claim: *sales contributes to conceiving, producing, and delivering customer value by understanding customers' and/or sellers' needs and fulfilling them with the bundle of goods and services* (Haas *et al.*, 2012, p.94).

Work is an activity to execute ordered tasks by priority, function and sequence. The worker fulfils these tasks using systems and procedures, and supporting behavioural norms. In this context BDMs apply skills sets, expertise and creative initiative as individuals or conceptually in consort with other specialist functions - procurement and bid management - to configure requirements into value propositions. How well this is done by main contractors, depends upon the quality of individual and functional support. Securing sales and configuring value proposition are key BDM criteria.

Securing sales through pipeline management was the prime transactional BDM task under the marketing mix (Preece *et al.*, 2003). The task has transitioned towards building relationships to add value to secure firm growth through repeat business (Smyth, 2015). A recent shift has been to apply the theoretical lens of S-DL, which analyses the co-creation of value (Vargo and Lusch, 2016). Applying S-DL to enhance value creation in practice has yet to occur in construction.

Relationship marketing requires resource commitment to embed systems and procedures (Coviello and Brodie, 1998). Implementation requires dedicated actors (Homburg *et al.*, 2002) to carry out organised activities with a degree of formalisation (Leonidou *et al.*, 2006). Certain main contractors have adopted tools of relationship

management to coordinate these activities, such as key account management (KAM), yet many BDM activities and task coordination have been left to individual responsibility (Smyth, 2015). This reliance upon BDMs as workers to coordinate the sales effort is therefore critical in the ability of the firm to help configure value propositions and secure (repeat) business for firm growth.

Conceptually BDMs align their actions to client needs to inform the way value is configured (Ming-Huei and Wen-Chiung, 2011). BDMs use personal and team skills to develop interactions, either supported by management systems and procedures, or through reliance upon individual initiative and responsible action. Ming-Huei and Wen-Chiung (2011) propose several stages: 1. Exploration *phase*, where power is asymmetric (cf. Mayo *et al.*, 1998). In so doing, BDMs try to generate interactions to help form psychological contracts and behaviourally induce a better balance of power (cf. Kang *et al.*, 2009); following on, 2. *Build up phase*, where interactions aim to establish behavioural norms through identifying mutual interests and agreeing goals - such norms can be decisive to mitigate clients using asymmetric power to induce dependency, or to help configure value propositions to deliver benefits and impact in use and context (cf. Vargo and Lusch, 2016); 3. *Maturity phase*, where resource and leadership commitment induce relationship commitment and leads to relationship management and collaboration during delivery (Smyth, 2015).

BDM tasks include inter-organisational coordination through interactions (e.g. Grönroos and Voima, 2013; Vargo and Lusch, 2016). The goal is to induce the necessary understanding and hence identify the potential for co-created value. BDMs have a key outward and inward facing role. The external BDM tasks involve, a) listening to assimilate the technical requirements and meaning of the actors on the client side - procurement, project managers, users, facilities and asset managers; b) understanding the service value expected that can be realised; c) reflection and learning to refine requirements for customised content and tailored service provision to create potential propositions of high value in use and context; and d) coordinated leadership to align supply chain capabilities to the requirements and deliver according to the value propositions. The internal BDM tasks involve cross-functional working to configure valuable customised and tailored solutions from generic templates - working with bid management and procurement to configure the value propositions. The BDM role also conceptually continues into delivery to set the behavioural norms and psychological contract during construction on site.

This paper uses the S-DL lens to assess the BDM contribution to the co-creation of value in two ways: i) value in use and context as service provision during delivery; ii) value in terms of benefits and impact post-completion. The assessment of the BDM role and activities necessarily and inclusively acknowledges the range of theoretical influences on practices, namely the transactional marketing (e.g. McCarthy, 1994), relationship marketing (e.g. Grönroos, 2000) and also S-DL (Vargo and Lusch, 2016).

METHODOLOGY AND METHODS

An interpretative methodology was applied, respecting value judgments and information provided by respondents in their working context (Denzin, 2002). Understanding of attitudes, levels of commitment, actions and behaviour was important in interpreting, identifying meaningful patterns of events, and drawing attention to outcomes of significance in a realistic way.

Data was collected using semi-structured interviews since the economic downturn. The empirical examination addresses the extent to which practice aligns with theory. Thus, marketing theory, drawing upon the marketing mix, relationship marketing and S-DL, was used to inform the open-ended questions, although S-DL was applied as the lens for analysis. The focus was upon main contractors. Interviews were undertaken across 9 main contractors and 26 semi-structured interviews were conducted. A layered approach emerged with considerable depth in one firm, BranCo, permitting more follow up questions in the 9 interviews. Reasonable depth was achieved in 3 other firms, and access in a further 5 firms allowed singular interviews for comparative purposes (Table 1).

Table 1: Schedule of firms and interviews

Firm	Prime Activities	BDM Interviews
BranCo	Civil Engineering	9
EUCo	Building and Civil Engineering	5
UKCo	Civil Engineering	3
EuroCo	Building and Civil Engineering	4
BritCo	Building and Fit Out	1
FinCo	Building	1
ElecCo	Civil and Electrical Engineering	1
BudCo	Civil Engineering	1
AntCo	Building	1

Interviewees reported on their activities. Self-reporting incurs bias depending upon the psychological condition of interviewees and what is being reported upon (Wilson and Dunn, 2004). Interviewees are optimistic about their own role and a negative about task performance (Kluger and DeNisi, 1996). Abilities tend to be positively exaggerated while behavioural discrepancies and poor performance are negatively reported so that the individual looks good at the expense of the employer.

FINDINGS AND ANALYSIS

BDM tasks

Business development prior to a project

This is equivalent to the exploration phase (Ming-Huei and Wen-Chiung, 2011). Prior to any project, contact was established with potential clients or maintained with existing clients. Previous research shows that BDMs were highly protective of such contacts, applying a transactional mind set (Smyth, 2015). A partially transformational and systematic approach was now evident. A senior BDM perceived the role as developing market share and gaining entry to new markets at the "incubating level" (AntCo BDM interview). This task was formally documented in some of the firms. EUCo produced its first marketing plan in 2008. EuroCo BDMs produced market summaries, a marketing business plan and customer plans for key clients. EUCo BDMs were briefed to gather background information of target clients, their contacts, communicate the information and prepare for the first contact with the targeted client. Follow up meetings aligned personnel with their counterparts on the client side wherever possible (EUCo and EuroCo BDM interviews).

Customer relationship management (CRM) software database packages were tools used to record interpersonal contacts and client information. CRM systems employed included Salesforce® by BranCo and Pursuit® by EUCo. In BudCo, the CRM system was purely used to aid the transactional pipeline management of contracts (BDM interview). There were low levels of CRM engagement by BDMs and other staff, although in BranCo there was concerted management commitment to drive up engagement. Elsewhere, it was a low priority as there were no personal consequences for low or zero engagement levels, for example in BritCo. In a few firms CRM was used to map client decision-makers by job title, scope of role and decision-making power and influence, profile and motivation. In BranCo it was used at firm, programme and project levels for key contacts (BDM interviews). In some firms, only job titles and roles were mapped. Overall, this low engagement constrained coordination of interactions with clients and limited interaction for cross-functional coordination. There was concerted, although restrained, relationship building in the build-up phase prior to any project (cf. Ming-Huei and Wen-Chiung, 2011).

At the project front-end during business development

The build-up phase for selling is under way during this stage (cf. Ming-Huei and Wen-Chiung, 2011). All BDMs are responsible for information gathering. BDMs referred to understanding "client drivers" as the way to identify and align value: "If you know the drivers you can recognise what opportunities are likely to have most success" (EUCo BDM). Yet, the meaning of 'drivers' among BDMs depended upon individual interpretation rather than firm guidance. For some BDMs, 'drivers' meant obtaining the documented requirements, to others it meant identifying a set of expectations and unarticulated project requirements, around which value propositions could be configured, and, to a very few it was about understanding the service expectations. Interpretations were informed by engineering and technical expertise; not by service outcomes (e.g. EUCo BDMs; cf. Vargo and Lusch, 2016). As a result there was a widespread view that was summed up as, "the company does not recognise itself as a service provider" (EUCo BDM). BDMs were involved up to prequalification, but less so during bid management and to a very limited degree during delivery, a disjuncture occurring between the BDM and bid management functions in most of the firms. One BDM stated that value is largely identified pre-prequalification: "It is hard to shoehorn those things in post-prequalification" (EUCo BDM). This is evidence of a residual marketing mix approach of transactional pipeline management to secure contracts, sometimes encouraged via incentive payments.

A maturity phase is entered into prior to bidding (cf. (Ming-Huei and Wen-Chiung, 2011). In EUCo, BDMs were reported as having to liaise with other departments. It was largely collaborative, yet there were problems, for example obtaining access to people or sourcing a testimony to demonstrate a capability (EUCo BDM interview). Collaboration was used to mobilise information for prequalification; it was not used to configure winning value propositions during bid management. EuroCo recognised the market has changed, efficiency being a prerequisite and thus added value being needed to win bids: the aim is "to shape the project" using the relationships (EuroCo BDM). Shaping did not typically carry through to procurement and bid management.

At the project front-end during bid management

A mature sales process culminates in the bid management function (cf. Ming-Huei and Wen-Chiung, 2011). BDM conceptually should work with the bid management function. ElecCo, as a main engineering contactor that is part of an industrial

manufacturing and project service group, claimed to be robust at information transfer and collaboration between BDM and bid management (ElecCo BDM interview). Processes were embedded across business units. ElecCo had co-located BDM and bid management, yet co-location did not help integration in BritCo and FinCo (BDM interviews). Integration was variable in BranCo. Another BDM said she took responsibility for ensuring coordination: a) talking and listening to clients, b) understanding the business, c) critically liaising with estimating teams to help configure winning value propositions, d) liaison with the production director to ensure value proposition delivery, e) continuing a watching brief during delivery (BranCo BDM interview). In EUCo, there was inconsistent involvement in tenders to get *"the theme running through"* (BDM interview), foreclosing effectively co-created value propositions from prior client interactions. In BudCo, effective knowledge sharing at the front-end and from site was reported as a way of developing winning value propositions (BDM interview). There was a system in AntCo and BranCo to help handover from the BDMs to the bid management team (BDM interviews). BranCo BDMs had explicit input into the winning value propositions, including the "soft tender content" to improve the service value (BDM interview).

Making client promises to enhance value propositions posed problems. BDMs claimed they lacked confidence that the service or content would be delivered during construction (BranCo, EUCo and UKCo BDM interviews). In EUCo 70% of BDMs were reactive and unwilling to make promises or service commitments (BDM interview). UKCo stated that value was "timidly" levered due to lack of resources committed by management to align (added) value to client's needs (BDM interview). There were also insufficient systems to manage value from the front-end to delivery (BranCo and EUCo BDMs interviews; Smyth, 2015). Enhancing value propositions did not yield financial payback, except in ElecCo. Firm growth was enhanced, but managers did not convey this benefit to those in construction operations. Leadership commitment for business development was low, although BranCo, ElecCo and BudCo claimed to pay attention to leadership and growth (BDM interviews).

Construction delivery and post-completion

BDM actions during construction were minimal. UKCo BDMs were tasked with involvement during delivery, yet "in practice it never happens". EuroCo BDMs were involved in collecting KPIs. In EUCo involvement extended to conducting 6-monthly client interviews to get feedback beyond the KPI measures. They were inconsistently conducted in practice (UKCo, EuroCo and EUCo interviews). BDMs were not involved in any projects post-completion to learn lessons from co-created value in use and context: feedback to create future value propositions was absent. This limited engagement constrained value co-creation viewed through the S-DL lens.

BDM time allocation to task types was enabled in BranCo, because a senior BDM took interest in the research, encouraging extra interviews and data collection (Table 1). Table 2 on the next page sets out the self-reported prime activities of 7 of the BDMs. BranCo BDMs spent most time on administration (c.25%). Following leads, tender stage actions and client management were each given c.15% of the time available, while lead generation was low (<5%). Tasks across the firms were variously emphasised by BDMs around perceptions of responsibility and preference. A coherent management plan for BDM task conduct was absent or unsystematic in all the firms.

BDM behaviour and norms

A relational mind set was present in the firms, a senior BDM reporting: *"It is all about people and relationships"* (EUCo BDM interview). Senior management reinforced this notion, yet did not provide support, guidance or formal procedures. Relationship development relied upon individual behaviour. AntCo claimed a cognitive approach to norm development: "It boils down to some trusted relationships", hence, "there's a lot of behavioural-cultural work that goes on" (BDM interview). Maintaining high levels of interaction was reported for developing winning value propositions: "having conversations" and "keeping them warm"; a close relationship was present when there was a continuous "willingness to partake in dialogue" (BranCo BDMs interviews).

Table 2: Days per week spent on prime BDMs activities

Activity	BDMs						
	No.1	No.2	No.3	No.4	No.5	No.6	No.7
Generating leads and OJEU notices	1.0	0.5					
Following leads	2.0	1.0	1.5			0.25	0.5
Prequalification			1.5	1.0	0.5	0.25	
Tender stage actions		2.5	0.5	1.0	1.0	0.25	
Watching brief during delivery	1.0	0.5				1.5	
Client and key account management	1.0			1.0	0.5	1.0	2.0
Administration	0.5		1.0	2.0	3.0	1.75	0.5
Contingency and other	0.5						2.0
Equivalent total of days	6	6	4.5	5.0	5.0	5.0	5.0

The project was the prime unit of consideration among BDMs. They placed clients and service as secondary units of consideration. In BranCo thinking and action was largely bid-by-bid, despite an emphasis on relationship marketing (BDMs interviews). BDMs were described as a disparate group (EUCo BDM interview), and relationship building was seen as a means to improve information gathering (e.g. EUCo and BritCo BDM interviews). Others saw it as a means to improve strike rates in prequalification and bidding. The feed into relationship marketing or a general collaborative approach through relational contracting during delivery was not to the fore (e.g. EUCo BDM interview); co-created value was not cognitively considered. UKCo adopted a network approach to building relationships, yet these were shallow at the firm level, although some BDMs built strong relationships. The approach was "very short-term" and "quite open and loose" (UKCo BDM interview).

BranCo adopted relationship marketing principles. There was some management guidance on relationship building, although BDMs did not always comply. There were no clear guidelines as to what a valuable relationship looked like in any of the firms, and thus, around norms for interaction to identify and configure value propositions. There was no awareness of the concept the co-creation of value among BDMs. Behaviours did not emerge into sustained norms: it was stated that learning from behavioural practices was difficult. Thus, formal procedures did not emerge to generate norms and this was a barrier to BDM and subsequent performance (EUCo

and BranCo BDM interviews). BranCo engaged in the research and asked for feedback on norms of trust that BDMs had in the organisation (Table 3).

Self-reporting is biased (Wilson and Dunn, 2004), over-emphasising levels of personal confidence. Yet the low levels of trust and confidence in the firm informed (sub-optimal) BDM actions and behaviour. BranCo was the most proactive and engaged in effective BDM activities. The low scores show it takes few marketing improvements to make a substantive difference, while indirectly showing how far leadership and resource commitment was behind the marketing strategic objectives of the firm.

Table 3: Levels of BranCo BDM trust, confidence and self-reported alignment to culture

BDM Level	Trust		Confidence		Alignment to Culture
	Organisational	Personal	Organisational	Personal	
High	2	7	2	7	6
Medium	2	1	3	1	1
Low	4		4		1

Firm leadership commitment and investment to processes

A formal approach to relationship marketing was reported as being "fairly simplistic" (EUCo BDM interview). The relationship marketing principles adopted were partial and poorly supported across the firms (cf. Smyth, 2015). What each client generically valued was overlooked and specific value enhancement was underplayed, hindering BDM and firm learning for developing tailored services and customised content as value propositions. Project-by-project, BDMs draw in senior management and technical personnel to develop relationships up to 3-4 months prior to prequalification (EUCo BDM interview). A long-term view with a client and service focus for relationship marketing and enhancing co-created value was largely absent.

BDMs generally did not make service commitments and promises to clients as part of any enhanced value proposition. There was a pattern of low-level resource allocation and commitment to BDMs, and indeed, at the whole front-end to develop winning value propositions (e.g. EUCo and UKCo BDM interviews). BDMs were isolated in the hierarchy regarding resources and leadership support (e.g. EuroCo and BranCo BDMs interviews). This was said to be changing in BranCo and the adoption of relationship marketing principles was improving resource allocation hence reducing hierarchical "blockers" in the firm. Yet, it was reported that BranCo senior management had poor awareness levels of relationship marketing (BDMs interviews). Yet overall, BDMs did not appear quite as isolated at the front-end as previous literature has reported (e.g. Pinto and Covin, 1992). This does not imply effective integration (cf. Smyth, 2015), but suggests improvement in this respect.

CONCLUSION AND RECOMMENDATIONS

The research *aimed* to address the BDM contribution to value creation. Previous research found low integration between marketing and other functions (Smyth, 2015). The research *objective* was to evaluate BDM actions and behaviour for forming value propositions. Overall, it was found that BDM tasks are increasingly becoming more systematically conducted when set against previous research. The intent is reasonably sound yet they lack firm support. Firms are reliant upon individual rather than managed action. The theory-practice gap remains broad. An evaluation of the

appropriateness of practitioner work is provided as a conclusion.

BDM tasks were conducted with variance and different emphases both in and between the firms. While some differences are to be expected, some congruence would also be expected across and especially in the firms to support the espoused transition from a transactional to relationship marketing. Tasks were conducted according to individual BDM preference and perceptions of responsibilities. Perceptions resided in a transactional mind set among many BDMs. The project remained the prime unit of consideration without a corresponding focus upon the client and service provision. Establishing aligned behavioural norms and supporting these in the firms was underdeveloped. Formal procedures did not therefore emerge, or become identified by the BDMs and management, to become embedded practice. However, behaviours have become more collaborative and relationship building appreciated, from which BDMs claimed benefits flowed. Thus, improved leadership and resource commitment could further support the strategic objectives and induce better BDM performance. BDMs were minimally involved in configuring value propositions and thus value co-creation in use and context, viewed through the S-DL lens (Vargo and Lusch, 2016).

It appears that BDMs are less isolated at the front-end than in the past (cf. Pinto and Covin, 1992). The main weakness is vertical - the lack of senior management awareness, leadership and resource allocation. This needs to be addressed by BDMs in their role as value creation workers.

Overall, a phased approach to business development from exploration, through build up to a mature approach was not fully evident (cf. Ming-Huei and Wen-Chiung, 2011). Value was being identified and configured at a basic level to meet requirements, falling short of the potential during the sales process (Haas *et al.*, 2012), and seen through the S-DL lens (Vargo and Lusch, 2016). Awareness creation, developing systems and procedures, and norms is a senior management task, yet is driven by BDM theorisation and practical actions. The recommendations reflect the BDM role, and emanate from the original contribution to examine BDM as workers for the creation of service and construction value.

Recommendations for research: (i) further research into the extent of influence of BDMs upon senior management in order to propose change, and hence, challenge the transactional norms of senior management, especially financial management; (ii) discrete and detailed examination of BDM activity along the project lifecycle; (iii) applying inductive analysis to examine the extent of applicability of S-DL to asset specific markets, such as construction. Recommendations for practice: (a) BDMs to promote awareness creation and learning opportunities to engage management and practitioners in the hierarchy and along the project lifecycle; (b) BDMs to challenge senior management around espoused strategic objectives in relation to daily practices in resource and leadership commitment; (c) BDMs to demand increased cross-functional working to improve coordination and integration for configuring and delivering value propositions.

REFERENCES

Coviello, M E and Brodie, R J (1998) From transaction to relationship marketing: An investigation of managerial perspectives and practices. *Journal of Strategic Marketing*, **6**(3), 171-186.

Denzin, N K (2002) The interpretive process. *In*: A M Huberman and M B Miles (Eds.) *The Qualitative Researcher's Companion*, Thousand Oaks: Sage Publications, 349-366.

Grönroos, C (2000) *Service Management And Marketing: Customer Management in Service Competition (2nd Edition)*. Chichester: Wiley.

Grönroos, C (2011) A service perspective on business relationships: The value creation, interaction and marketing interface. *Industrial Marketing Management*, **40**(2), 240-247.

Grönroos, C and Voima, P (2013) Critical service logic: Making sense of value creation and co-creation. *Journal of the Academy of Marketing Science*, **41**(2), 133-150.

Haas, A, Snehota, I and Corsaro, D (2012) Creating value in business relationships: The role of sales. *Industrial Marketing Management*, **41**(1), 94-105.

Homburg, C, Workman, J P and Jensen, O (2002) A configurational perspective on key account management. *Journal of Marketing*, **66**(2), 38-60.

Kang, M P, Mahoney, J T and Tan, D C (2009) Why firms make unilateral investments specific to other firms: The case of OEM suppliers. *Strategic Management Journal*, **30**(2), 117-135.

Kluger, A N and DeNisi, A (1996) The effects of feedback interventions on performance: A historical review, a meta-analysis, and a preliminary feedback intervention theory. *Psychological Bulletin*, **119**(2), 254-284.

Leonidou, L C, Phlihawadana, D and Theodosiou, M (2006) An integrated model of behavioral dimensions of industrial buyer-seller relationships. *European Journal of Marketing*, **40**(1/2), 145-173.

Mayo, D T, Richardson, L D and Simpson, J T (1998) The differential effects of the uses of power sources and the influence strategies on channel satisfaction. *Journal of Marketing Theory and Practice*, **6**(2), 16-25.

McCarthy, E J (1964) *Basic Marketing: a managerial approach*, Homewood, Irwin Inc.

Ming-Huei, H and Wen-Chiung, C (2011) Managing key account portfolios across the process of relationship development: A value proposition-desired value alignment perspective. *Journal of Business-to-Business Marketing*, **18**(1), 83-119.

Pinto, J K and Covin, J G (1992) Project marketing: Detailing the project manager's hidden responsibility. *Project Management Journal*, **22**, 29-34.

Preece, C N, Smith, P and Moodley, K (2003) *Construction Business Development*. Oxford: Butterworth-Heinemann.

Smyth, H J (2015) *Market Management and Project Business Development*. Abingdon: Routledge.

Vargo, S L and Lusch, R F (2016) Institutions and axioms: An extension and update of service-dominant logic. *Journal of the Academy of Marketing Science*, **44**(1), 5-23.

Wilson, T D and Dunn, E W (2004) Self-knowledge: Its limits, value, and potential for improvement. *Annual Review of Psychology*, **55**(1), 493-518.

Woodruff, R B (1997) Customer value: The next source for competitive advantage. *Journal of Academy of Marketing Science*, **25**(2), 139-153.

THE BUSINESS LOGIC OF CHINESE CONSTRUCTION COMPANIES INVESTING IN THE UK INFRASTRUCTURE SECTOR

Hua Wang[1], Martin Sexton and Shu-Ling Lu

School of Construction Management and Engineering, Whiteknights, P O Box 225, Reading, Berkshire, RG6 6AY, UK

The expansion of global construction markets has substantial implications for companies engaged in cross-border transactions and financing. The convergence of the UK and the People's Republic of China (PRC) infrastructure policy agendas has led to significant investment from Chinese construction companies in the UK infrastructure sector. On the demand side, the UK Government's National Infrastructure Plan sets out a wide range of investment priorities. The PRC Government's One Belt, One Road strategy, on the supply side, has prioritized outward foreign investment into Eurasia. The international business literature on foreign market entry with a specific organizational capability perspective is drawn upon to understand the rationale for Chinese construction companies to invest in the UK infrastructure market. Two Chinese construction multinational companies currently engaging in UK infrastructure projects are studied through interpreting secondary sources. Findings indicate that their pursuit of hybrid market entry modes are underpinned by corresponding hybrid capability exploitation and acquisition motivations.

Keywords: Chinese construction companies, infrastructure, investment

INTRODUCTION

Construction multinational companies (MNCs) are rapidly expanding their global activities. The top 250 international contractors, which are typical MNCs in terms of organization and management, grew their contracting revenue from projects outside their home countries from £99.77 billion in 2005 to £274.73 billion in 2014 (Engineering News-Record, 2015). Among them, 65 contractors are Chinese companies. There are a growing number of Chinese construction MNCs operating in the UK. The expansion of Chinese MNC activity has been facilitated to a significant degree by the establishment of bilateral agreements between the People's Republic of China (PRC) and the United Kingdom (UK). The UK Government initiated the National Infrastructure Plan, which set out a wide range of investment opportunities (HM Treasury, 2015). At the same time, the PRC Government's Belt and Road Initiative has prioritised outward foreign direct investment (FDI) into Eurasia (National Development and Reform Commission of the People's Republic of China, 2015). There are indications that China will "commit to the UK economy, with 112 projects, including 13 investments from Hong Kong" (UK Trade and Investment, 2015: 13). The value of construction projects in the UK by Chinese contractors has

[1] hua.wang@pgr.reading.ac.uk

Wang, H, Sexton, M and Lu, S-L (2016) The Business Logic of Chinese Construction Companies Investing in the UK Infrastructure Sector. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference,* 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1079-1088.

grown from £26.03 million in 2004 to £341.51 million in 2014 (National Bureau of Statistics of the People's Republic of China, Undated).

The increasingly active status of Chinese construction companies in the international market has been recognised by academic scholars. Zhao and Shen (2008), for example, claim that the competitiveness of Chinese construction companies is a product of the encouragement and support from the Chinese government, financial support from Chinese state-owned banks, and the demand from Chinese clients. Chen and Orr (2009) analysed the specific mechanisms established by the Chinese government to promote Chinese construction companies going overseas and their foreign market entry strategies. However, previous studies are mainly based on African or Asian countries which were then the priority overseas markets for Chinese contractors (Chen and Orr, 2009). Pinsent Masons (2014) has reported the increase of Chinese investment and its impact on the UK infrastructure and real estate. This research has furthered academic understanding of the overall volume of Chinese construction MNC activity in the UK, but scholars have yet to fully explore the business logic that underpins the investment decisions. The aim of this paper is to further understanding of the business logic by examining the market entry motivations and modes of two Chinese construction companies investing in the UK infrastructure sector. The case study findings contribute by theoretically extending the role of market entry strategies to understand the business logic of FDI decisions by MNCs.

The structure of this paper is organised as follows. First, the organisational capability perspective is drawn upon to understand the general business logic of MNCs. Second, the research method for the case study is described. Third, the findings from the case study are given. Finally, discussion and conclusions are offered on the implications of the case results for market entry motivations and modes of Chinese construction MNCs.

THEORETICAL FRAMING

Foreign market entry has been a significant issue in the international business research and has focused on the organisational arrangements that companies adopt to conduct international business, such as joint ventures and wholly owned subsidiaries (Andersen, 1997). Early research developed an internationalisation model to describe the stages that companies enter a new country: no regular exports, export through agents, setting up sales subsidiaries and, finally, building local production plants (Johanson and Wiedersheim-Paul, 1975). Later, the internationalisation pattern was further explained as a gradual process of acquiring, integrating and utilising knowledge (Johanson and Vahlne, 1977).

The interest in the knowledge incentives of internationalisation led to the incorporation of the organisational capability perspective to explain the underpinning business logic for different market entry modes. This perspective recognises a company as a package of relatively static resources, which can be transformed into capabilities through interactions of individuals, organisations and technology (Andersen, 1997). These distinctive capabilities are characterised as company specific, difficult for others to imitate and being able to produce abnormal profit (Luo, 2002).

The organisational capability perspective framed the strategic decision-making about market entry mode as one based on the contribution to a company’s capabilities (Madhok, 1997). From this perspective, companies’ selection of market entry mode is

governed by whether the motivation is capability exploitation (to exploit existing capabilities), or capability acquisition (to acquire new capabilities from the host company) (Madhok, 1997). Commentators have argued that for the capability exploitation logic, the appropriate organisational arrangement is the independent mode (often in the form of a wholly owned subsidiary); and, for capability acquisition the collaborative mode (commonly through the establishment of a joint venture) (Anderson, 1997; Madhok, 1997; Luo, 2002).

Research has shed some useful light on the market entry motivation / mode dynamic within an infrastructure sector context. Walker and Johannes (2003), for example, found that many infrastructure projects in Hong Kong were delivered using joint ventures (collaborative modes), and the principal motivation to adopt the collaborative mode was to provide adequate financial strength for a specific "capital-hungry" infrastructures project. Other research has concluded that the independent market entry mode is appropriate in particular situations. Chen and Orr (2009), for instance, noted that Chinese construction MNCs in the African market tended to set up wholly owned subsidiaries rather than joint ventures, as local firms did not possess capabilities that they wanted to acquire.

In summary, the general and construction-specific MNC literatures are consistent in their assertion that there may be a link between capability exploitation and the independent entry mode, and between capability acquisition and the collaborative mode. This assertion is drawn on to interpret the business logic of Chinese construction MNCs, so the research question is framed as: what are the foreign market entry motivations of Chinese construction MNCs in the UK infrastructure sectors, and whether corresponding modes are adopted.

METHOD

The research findings are based on a case study of two Chinese MNCs operating in the UK: Beijing Construction Engineering Group International Company (BCEGI) and China General Nuclear Power Company (CGN). The cases were selected on the basis that they are Chinese construction companies involved in the two highest profile UK infrastructure projects in terms of project value and significance for UK security. Besides, BCEGI and CGN are among top Chinese contractors in annul contract avenue (Engineering News-Record, 2015). Secondary data were collected for each case from a diverse range of English and Chinese sources, including company official websites, company annual reports, online news reports, and research reports, searched by using each case company's name and project name as keywords. The time period of data collected was from 2013, when the UK project starts, to 2016. In total, about 93 articles were gathered for the BCEGI case, and 17 for the CGN case as it was still in an initial stage. The data were closely read and interpreted to identify capabilities that case study companies were seeking or exploiting and market enter modes that were utilized. A category of capabilities was developed and the supporting data were cited or quoted.

KEY RESULTS

Case 1: Beijing Construction Engineering Group International Company (BCEGI)

At present, BCEGI has set up branches in over twenty countries and undertakes housing and infrastructure construction in host countries. The BCEGI joined the Manchester Airport City project in October 2013, which is a £800 million expansion

of Manchester Airport and currently under construction. The project is developed through a joint venture partnership between the Manchester Airports Group Plc (MAG), BCEG, Carillion, and Greater Manchester Pension Fund, who hold the stake of 50%, 20%, 20% and 10% respectively (Construction Manager, 2013). The BCEGI is also acting as co-contractor with Carillion and undertaking half of the construction work (Construction Manager, 2013). Moreover, in November 2013, BCEGI founded a wholly owned subsidiary, BCEG International (UK) Ltd, whose function is not restricted to the Manchester Airport City project but is growing with some new business interests in and around the UK. Key results regarding which capabilities BCEGI can exploit and / or want to acquire are discussed below.

Exploit financing capability

One of the main reasons BCEGI was chosen as a partner by MAG is BCEGI's ability to directly invest in the project and potentially help with project financing. This view is captured by the Chief Executive of MAG stating that MAG had sought financial support from the state-owned Industrial and Commercial Bank of China (ICBC) (Beijing Construction Engineering Group, 2014).

Utilise government support

The reach of the UK-PRC business cooperation is partly due to the UK's willingness to accept foreign investment and the support from local governments. This is evident in BCEGI's confirmation of the cooperation during the UK Chancellor George Osborne's visit to the PRC in 2013 (Beijing Construction Engineering Group, 2014). Chinese investment in Manchester is recognised by the UK government as boosting the economy in the northern part of the UK (Prime Minister's Office, 2015). Furthermore, when BCEGI is searching for new business opportunities in the UK, it takes the availability of local government support into consideration (Beijing Construction Engineering Group, 2015).

Utilise being close to the consumer market

As an enterprise zone, Manchester Airport City needs to attract business into the area, and Chinese investors or manufacturers are targeted as the vast audience. This mission is showed in practice by making roadshows across three cities in the PRC in June 2014 (Beijing Construction Engineering Group, 2014). Having a Chinese contractor is helpful to bring Chinese consumers to Manchester Airport City as well as to Manchester Airport which is in need of Chinese tourists and students (Travelmail, 2013). When the partnership agreement between MAG and BCEGI was made, the Chief Executive of MAG ensured that the airport could secure a direct flight service to the Far East (Travelmail, 2013).

Exploit international experiences

The exploitation of international experiences that BCEGI has gathered in recent decades, particularly through working in the US and Canada, played an important role for BCEGI to secure the project in the UK (Beijing Construction Engineering Group, 2014). The international advantage is described by the President of BCEGI as "Now, we can get construction contract in the US, employ designers from the UK, let the Chinese team to optimize the design, and purchase cheap and fine Chinese material. In the head office at Beijing, we can mobilize global resources" (Economic Daily, 2015).

Understand local laws, regulations and contract systems

One of the main capabilities that Chinese companies need to develop is to understand and navigate the UK's complex regulations about project delivery and construction as

well as to understand relevant policies of European Union (EU) which the UK is a member country of (Pinsent Masons, 2014). As an international contractor, BCEGI is committed to act in the way of "Do in Rome as Rome does" in order to get familiar with local laws, contracts and regulations in project development (Construction Manager, 2013).

Learn and absorb project management skills
The BCEGI takes the Manchester Airport City project, its first project in the Europe, as an opportunity to learn UK project management practices; and, by doing so, to transform and upgrade its business operation to expand market in developed countries (Construction Manager, 2013). This is further explained by an economist at the think tank Centre for Economics and Business Research noting that "Chinese companies are now using their capacity to invest abroad as an opportunity to not only make lucrative financial returns, but also to get hold of valuable know-how in terms of project management in the operation of key infrastructure and other projects" (Liu, 2015).

Develop cross-cultural cooperation skills
The diversity of operation environments provides BCEGI a competitive knowledge base, and the cooperation with UK offers BCEGI an opportunity to develop its cross-cultural communication skills (Beijing Construction Engineering Group, 2014). The Manchester Airport City project is characterised as an extension of understanding between China and the UK (The Guardian, 2013). Furthermore, a new type of international project management model may be developed as both BCEGI and Carillion are acting as two different roles: the owner and contractor (Construction Manager, 2013).

Case 2: China General Nuclear Power Company (CGN)

The CGN is one of the largest nuclear operators in the PRC. The CGN started to investigate the UK nuclear market in 2011, and bid for Horizon Nuclear Power, a British energy company, in 2012 without success (The Paper, 2015). In October 2015, CGN signed a strategic investment agreement with Electricité de France (EDF) to develop nuclear projects together in the UK by the witness of David Cameron and the Chinese President Xi Jinping during President Xi's UK state visit (BBC News, 2015). While the final investment agreement has not been finalised, it may involve a buddle of three nuclear plants and may cooperate through a joint venture or a consortium according to the initial agreement (The Paper, 2015). This collaboration tends to start with Hinkley Point C in Somerset, followed by Sizewell C in Suffolk and Bradwell B in Essex (CGN and EDF Energy, 2015). The CGN tends to get one third share of the £18 billion Hinkley C project, while EDF may hold the remaining stake but it might sell another 15% stake (BBC News, 2015). The Sizewell C project may follow a similar investment structure, while the Bradwell B project tends to be led by CGN with a two thirds stakes (BBC News, 2015). The CGN has set up four wholly owned subsidiaries in the UK in February 2016 (Ministry of Commerce of the People's Republic of China, Undated). Three of subsidiaries are named after the three future nuclear projects in the UK, and the fourth one is to carry out the UK Generic Design Assessment for CGN's Hualong One nuclear power technology. Key findings from data analysis about capabilities that CGN may exploit and / or want to acquire are given below.

Exploit financing capability
EDF's nuclear project plan has been delayed, partly because of its financing position, which led the way to the Chinese investor CGN coming in. It is evident in that "EDF

needs the Chinese investment because it is burdened with high levels of debt and is expected to sell about £7.4 billion of assets in the next five years. Earlier in October, two of the world's biggest ratings agencies warned the company it faced credit-rating downgrades if Hinkley Point went ahead" (The Guardian, 2015).

Utilize government support
CGN's financing ability partly owes to the support from Chinese state-owned banks. In October 2015, CGN and China Development Bank signed a memorandum of understanding in London for the Hinkley C project financing, which means China Development Bank will provide CGN with low-cost financing and a full range of financial services for the Hinkley C project (China General Nuclear Power Company, 2015).

Exploit existing nuclear technology
According to the initial agreement between CGN and EDF, the first two nuclear projects will be built with the French technology, while the Bradwell B project, is intended to use Chinese technology (CGN and EDF Energy, 2015). Hualong One is developed by CGN and its Chinese partners, and it is claimed to have an equivalent safety level with the third-generation nuclear technology of the US, France and Russia (China News Service, 2015). Hualong One can be used in the UK only if it passes the Generic Design Assessment (CGN and EDF Energy, 2015). A nuclear power station in Guangxi, PRC is being built with Hualong One, and it tends to be the reference station for the Bradwell B project (China News Service, 2015). It is recognised that Bradwell B will be the first project that Chinese nuclear technology is imported to the western countries (China News Service, 2015). Furthermore, the technology will be used in the first two projects of the UK is not new to CGN as it is similar with the two nuclear reactors in Taishan, PRC which are developed by CGN and EDF (Rivaz, 2015).

Understand local regulations
CGN and EDF have had 30 years of cooperation since the Daya Bay Nuclear Power Plant in the PRC. Indeed, a global partnership agreement between CGN and EDF was signed in November 2007 for joint investment and technology development (The Paper, 2015). The UK has one of the most robust independent nuclear regulators in the world, which is the Office for Nuclear Regulation, and it took EDF four years to pass the Generic Design Assessment (Rivaz, 2015). The EDF intends to assist CGN to take the Chinese technology through the assessment by sharing its own experience (CGN and EDF Energy, 2015).

DISCUSSION

The results show that both case companies are motivated by both capability exploitation and capability acquisition. Correspondingly, both the independent mode and the collaborative mode are used in two cases. Table 1 summarises the specific business logic of Chinese construction MNCs that underpinned their decision to enter the UK infrastructure sector and what organisational arrangements are being used.

Market entry motivations

Both cases show that case study companies are motivated to exploit their financing ability supported by Chinese state-owned banks, which is consistent with the argument of Zhao and Shen (2008). In addition to the financial support, the Chinese government also facilitates project agreements through its state visit activities. This was evident in case 2 that CGN and EDF signed the agreement during the PRC

President Xi's UK state visit. It is consistent with the research of Zhao and Shen (2008) who argue that the Chinese government has been encouraging Chinese companies to enter into overseas markets by making bilateral and multilateral agreements with foreign countries, improving administration efficiency and reducing custom duties. Moreover, we find the support from governments is not unilateral. The state visit of the UK government also promotes the cooperation between Chinese and British companies. Besides, both case study companies intend to acquire new capabilities. As argued by Meyer (2015), MNCs from emerging economy countries tend to pursue foreign market by investment in order to build capability to enhance the operations in other markets, especially the home country market.

Table 1: Business logic of Chinese construction MNCs

Case no.	The market entry motivation		The market entry mode	
	Capability exploitation	Capability acquisition	Independent mode	Collaborative mode
Case 1	- Exploit financing capability - Utilise government support - Utilise being close to the consumer market - Exploit international experiences	- Understand local laws, regulations and contract systems - Learn and absorb project management skills - Develop cross-cultural cooperation skills	Wholly owned subsidiaries are founded	A joint venture is set up
Case 2	- Exploit financing capability - Utilise government support - Exploit exiting nuclear technology	- Understand local regulations	Wholly owned subsidiaries are founded	A joint venture or a consortium tends to be built

Market entry modes

How organizational arrangements are used to fulfil the capability aim is consistent with the literature. In other words, the collaborative mode can be used to acquire knowledge about local regulation environments or to learn advanced management skills, and the independent mode can be used to exploit its existing capabilities (Madhok, 1997). However, in our cases, we find that the two modes are not an either-or situation as both are used in our two case companies. Both companies tend to get shares from projects through joining a joint venture or a consortium, and at the same time wholly owned subsidiaries were set up for seeking further project opportunities.

Chen and Messner (2011) have similar observation in construction projects where subsidiaries are used to track project opportunities on the behalf of parent companies, and a joint venture with a local company will be built after the project is granted. Partnering with existing market participants can facilitate MNCs successfully bid for projects and get into a new market to export its existing capabilities, and the wholly owned subsidiaries can be the carrier of new capabilities acquired. The hybrid combination of two motivations and two market entry modes may be the special characteristics for project-based companies, as Walker and Johannes (2003) argue that choosing joint ventures partnership in infrastructure projects can offer an integrated service package to customers. Through the joint venture, profits and other responsibilities are assigned among shareholders of a specific project. At the same time, the independent role can be maintained by owning wholly owned subsidiaries to build reputation and explore further opportunities in the UK or even the Europe.

CONCLUSION

The research offers new empirical and theoretical insights. Empirically, previous understanding about the business logic of Chinese construction MNCs is based primarily on the African and Asian markets. The case study results indicate that the business logic underpinning the Chinese MNCs' decision to enter the UK infrastructure sector were found to be driven by both capability exploitation and acquisition, and this motivation leads to both independent and collaborative market entry modes mobilized by the case companies. The findings complement and extend previous research on Chinese construction MNCs which identified different market entry strategies (cf. Chen and Orr, 2009; Walker and Johannes, 2003) by showing that Chinese MNCs tend to pursue multiple strategies on the same infrastructure projects to secure simultaneous capability exploitation and acquisition goals.

Theoretically, the results have extended the prevailing binary independent versus collaborative market entry modes articulated in the MNC literature (cf. Madhok, 1997, Luo, 2002) by demonstrating that companies can operate hybrid strategies consisting of both modes. The hybrid strategies led theoretical colouring to the argument that MNCs create competitive advantage by both leveraging core capabilities across all their international operations (capability exploitation) whilst developing new capabilities from those international activities (capability acquisition).

ACKNOWLEDGEMENT

This work was supported by the joint funding from the University of Reading and the China Scholarship Council (CSC).

REFERENCES

Andersen, O (1997) Internationalization and market entry mode: A review of theories and conceptual frameworks. *MIR: Management International Review*, **37**, 27-42.

BBC News (2015) *Hinkley Point Nuclear Agreement Reached*. Available: http://www.bbc.co.uk/news/business-34587650 [Accessed April 02, 2016].

Beijing Construction Engineering Group (2014) 北京建工参建英国空港城项目. Available: http://www.bcegc.com/news/news_detail/61.html [Accessed March 22, 2016].

Beijing Construction Engineering Group (2015) 戴彬彬签署曼彻斯特空港城项目两项施工总承包协议. Available: http://www.bcegc.com/news/news_detail/932.html [Accessed March 22, 2016].

CGN and EDF Energy (2015) *Letter to the Local Community*. Available: http://www.bradwellb.co.uk/letter-to-the-local-community [Accessed April 02, 2016].

Chen, C. and Messner, J. (2011). Characterizing entry modes for international construction markets: Paving the way to a selection model. *Engineering, Construction and Architectural Management*, **18**(6), 547-567.

Chen, C and Orr, R J (2009) Chinese contractors in Africa: Home government support, coordination mechanisms, and market entry strategies. *Journal of Construction Engineering and Management*, **135**(11), 1201-1210.

China General Nuclear Power Company (2015) 中广核与国家开发银行签署英国新建核电项目融资合作备忘录. Available: http://www.cgnpc.com.cn/n471046/n471126/n471156/c1141467/content.html [Accessed April 02, 2016].

China News Service (2015) 中广核与法国电力签英国核电项目投资协议. Available: http://www.chinanews.com/cj/2015/10-21/7582390.shtml [Accessed March 22, 2016].

Construction Manager (2013) *Manchester Airport City Is Gateway To Europe*. Available: http://www.construction-manager.co.uk/news/manchester-airport-city-gateway-europe-says-bcegs-/ [Accessed March 22, 2016].

Economic Daily (2015) 北京建工：实力“出海”筑品牌. Available: http://politics.people.com.cn/n/2015/0715/c70731-27304934.html [Accessed March 22, 2016].

Engineering News-Record (2015) *Engineering News-Record Top Lists*. Available: http://www.enr.com/toplists [Accessed March 17, 2016].

HM Treasury (2015) *National Infrastructure Plan*. Available: https://www.gov.uk/government/collections/national-infrastructure-plan [Accessed March 17, 2016].

Johanson, J and Vahlne, J-E (1977) The internationalization process of the firm: A model of knowledge development and increasing foreign market commitments. *Journal of International Business Studies*, **8**(1), 23-32.

Johanson, J and Wiedersheim-Paul, F (1975) The internationalization of the firm: Four Swedish cases. *Journal of Management Studies*, **12**(3), 305-323.

Liu, C (2015) *UK Infrastructure Attracts Chinese Company Investment*. Available: http://www.chinadaily.com.cn/world/2015-11/13/content_22443739.htm [Accessed April 02, 2016].

Luo, Y (2002) Capability exploitation and building in a foreign market: Implications for multinational enterprises. *Organization Science*, **13**(1), 48-63.

Madhok, A (1997) Cost, value and foreign market entry mode: The transaction and the firm. *Strategic Management Journal*, **18**(1), 39-61.

Meyer, K E (2015) What is “strategic asset seeking FDI”? *The Multinational Business Review*, **23**(1), 57-66.

Ministry of Commerce of the People's Republic of China (No Date) *The Directory Of Overseas Investment Companies / Institutions*. Available: http://www.mofcom.gov.cn/ [Accessed March 17, 2016].

National Bureau of Statistics of the People's Republic of China (No Date) *The Statistical Yearbook Of The People's Republic Of China*. Available: http://www.stats.gov.cn/tjsj/ndsj/ [Accessed March 17, 2016].

National Development and Reform Commission of the People's Republic of China (2015) *Vision and Actions on Jointly Building Silk Road Economic Belt and 21st-Century Maritime Silk Road*. Available: http://en.ndrc.gov.cn/newsrelease/201503/t20150330_669367.html [Accessed March 17, 2016].

Pinsent Masons (2014) *Can Chinese Investment Be A Game-Changer For UK Infrastructure*. Available: http://www.pminfrainvestmentreport.com/ [Accessed March 29 2016].

Prime Minister's Office (2015) *PM and Chinese President's Visit to the Northern Powerhouse Unlocks Investment*. Available: https://www.gov.uk/government/news/pm-and-chinese-presidents-visit-to-the-northern-powerhouse-unlocks-investment [Accessed March 22, 2016].

Rivaz, V de (2015) *Why We Should Welcome Chinese Investment in the UK's Nuclear Programme*. Available: http://www.telegraph.co.uk/finance/newsbysector/energy/11880767/Why-we-should-welcome-Chinese-investment-in-the-UKs-nuclear-programme.html [Accessed March 22, 2016].

The Guardian (2013) *China to Invest Millions in Manchester Airport Development*. Available: http://www.theguardian.com/business/2013/oct/14/china-invest-manchester-airport-city [Accessed March 22, 2016].

The Guardian (2015) *Work To Begin On Hinkley Point Reactor Within Weeks After China Deal Signed*. Available: http://www.theguardian.com/environment/2015/oct/21/hinkley-point-reactor-costs-rise-by-2bn-as-deal-confirmed [Accessed April 02, 2016].

The Paper (2015) 中广核是如何在老牌玩家云集的英国核电市场中脱颖而出的？ Available: http://www.thepaper.cn/newsDetail_forward_1388538_1 [Accessed April 02, 2016].

Travelmail (2013) *£800m Chinese Investment For Manchester's 'Airport City' As UK Visa Rules Are Relaxed*. Available: http://www.dailymail.co.uk/travel/article-2458582/800m-Chinese-investment-Manchesters-Airport-City-UK-visa-rules-relaxed.html [Accessed March 23 2016].

UK Trade & Investment (2015) *Inward Investment Report 2014 to 2015*. Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/435646/UKTI-Inward-Investment-Report-2014-to-2015.pdf.

Walker, D H and Johannes, D S (2003) Construction industry joint venture behaviour in Hong Kong: Designed for collaborative results? *International Journal of Project Management*, **21**(1), 39-49.

Zhao, Z Y and Shen, L Y (2008) Are Chinese contractors competitive in international markets. *Construction Management and Economics*, **26**(3), 225-236.

ENGINEERING COMPANIES STRATEGIZING GLOBALISATION

Martine Buser[1], Petra Bosch and Christian Koch

Division of Construction Management, The Department of Civil and Environmental Engineering, Chalmers University of Technology, SE- 412 96 Gothenburg, Sweden

The rapid globalisation of the construction market should bring new potential for the Engineering Construction (EC) industry in terms of collaboration inside and outside of the national borders. Especially, engineering outsourcing is established as a global sector practice and expected to be a booming business in the future. There is a rich literature describing possible strategies, organisational forms and set ups and potential benefits of these internationalisation processes. Besides, the challenges that these forms of cooperation may involve have also largely be identified and discussed. However, there is less focus on how these collaborations occur in practice, in particular how they are initiated and negotiated and in which context they take place. Looking at a small network of Swedish engineering companies which have been active on the globalised market, we followed their concrete considerations, choices and actions in developing contacts and creating collaboration with foreign partners. To do so, we draw on a strategy as practice approach. The practice perspective defines strategy as something performed by people opposed to something a company has, and identifies strategy as the strategic activities reiterated in time by the diverse actors interacting in an organizational context, i.e., strategizing. The empirical material consists mainly of a longitudinal case study of a small engineering company and its network trying to expand to China, including interviews of two project managers of other engineering companies who have also engaged in an internationalisation process. The results feature project managers as strategy practitioners, using, what appears mundane project management tools, yet contain the radical strategic moves of expanding to China. This praxis underlines the lack of classical long term strategy in favour of ad hoc solutions and the central role of project managers in creating these international projects.

Keywords: engineering companies, internationalisation, strategy as practice

INTRODUCTION

The current globalisation of the construction market offers new potential and threats for the Engineering Construction (EC) industry to benefit from collaboration inside and outside of the national borders. Especially, engineering outsourcing is established as a global sector practice and expected to be a booming business in the future worth hundreds of billions of USD by 2020, growing at almost 30% annually.

Engineering companies are indeed becoming more and more international. Large global players such as WSP and AECOM as well as Scandinavian actors such as COWI or Ramboll are penetrating the Swedish market. Furthermore, Swedish companies such as SWECO are expanding abroad. These companies have started sourcing infrastructure engineering processes and methods internationally and

[1] buser@chalmers.se

Buser, M Bosch, P and Koch, C (2016) Engineering Companies Strategizing Globalisation. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1089-1098.

developed competences in delivering both local and global attractive cost-efficient, high-value and sustainable solutions. Moreover, one can claim that project based organisations should enable the development of these kind of initiatives, through the autonomy of project managers or project "makers", that adopt any local or international approach that would be feasible in the single project.

A recent study of Swedish engineering firms, focusing on corporate management shows that a majority is reluctant to tackle the strategic choices of developing outside of Sweden (Hammarström *et al*., 2012). As this form of business development for the Swedish construction industry has not yet been studied in Sweden, we set out to do so.

The aim of this paper is to study how a small Swedish engineering company and its network are entering the globalised market by following their concrete considerations, choices and actions in developing contacts and creating collaboration with foreign partners. The paper is structured in a traditional way, starting with presenting our strategy as practice (SAP) theoretical frame, developing a method, describing the strategy of our case and analysing it with the SAP lenses to reach to some conclusions.

THEORETICAL FRAME

The conventional understanding of strategic management focuses on the formulation and implementation of chosen goals and initiatives decided by a company's top management building on the assessment of available resources and evaluation of the internal and external environments surrounding this company (Porter 1985, Mintzberg *et al*., 1998). In order to reach these goals numerous models have been developed to guide companies. Exhibiting clear subsequent stages, these models often include a diagnose phase followed by a plan of action, which needs to be diffused top down within the organisation (Porter 1985, Mintzberg & Lampel, 1999, Kim & Mauborgne 2005). However, studies of construction companies underline the strong autonomy of project managers to make decisions (Koch and Friis 2015) and the lack of success for centrally made decisions to be implemented by the employees.

To study how the internationalisation process is taking place, we choose to use the strategy-as-practice (SAP) approach. According to this approach 'doing strategy' is a dynamic entanglement of actors, the strategy practitioners, practices and praxis (Jarzabkowski & Spee, 2009; Whittington, 2006). Practices, of internal and external origin supply routines, discourses, concepts, recipes, which can be used in strategizing (Hodgkinson *et al*. 2006). They here refer to the various tools, norms, and procedures of strategy work, from analytical frameworks such as Porter's Five Forces to strategic planning routines such as strategy workshops (Vaara and Whittington 2012). Praxises in turn is what practitioners actually do in designing, shaping and implementing strategies such as strategic planning processes or meetings, where they mobilise and translate the practices into praxis. Practitioners are all those involved in, or seeking to influence, strategy-making. Importantly the SAP approach would suggest that formulation and execution are overlapping and views strategizing as a continual transformation of practices into praxis. As it derives, the SAP approach introduces a somewhat difficult distinction between practice and praxis and critics and contributors have pointed to develop even further variations of practice understanding within SAP (Rouleau, 2013). Here we will not differentiate between practices and praxis but focus on the strategic activities carried by the practitioners when engaging with internationalisation processes.

Even if SAP insist on a closeness to how strategy processes develop, the strand of approaches still rest with relatively traditional forms of hierarchical organisations. In SAP studies, strategy practitioners are predominantly top management and occasionally middle managers and consultants, but rarely employees (Jarzabkowski and Spee 2009, Vaara and Whittington 2012). This is in stark contrast to studies of strategizing in project-based organisations where project managers are recurrent actors (Koch and Friis 2015) and where large projects are likely to impact on strategy directions of the entire organisation.

Moreover, most SAP studies look at large organizations and the approach is rarely applied to SMEs. One exception is Friis (2013) which on the one hand demonstrates a case of involving the employees but on the other hand finds a clear dominance of the CEO, managers and consultants in the strategizing; a finding similar to Achtenhagen *et al*., (2013) and Nordqvist (2012). Also Achtenhagen *et al*. (2013) find a broad involvement of actors as characteristics in SMEs strategizing. They point at three critical capabilities, namely an orientation towards experimenting with and exploiting new business opportunities, a balanced use of resources, and developing and maintaining coherence between leadership, culture, and employee commitment (Achtenhagen *et al*., 2013). Moreover, strategy in construction SMEs is likely not explicitly formulated and documented in paper versions (Thuesen *et al*., 2010, Wandahl *et al*., 2010).

Summarising, our framework understands strategy as a continual practice carried out by strategy practitioners. In order to follow the internationalisation process strategy, we focus on the role and positions of the actors, the formulation decision process and the implementation.

METHOD

The objective of the study is to explore and articulate the dynamics of strategy practices as they unfold for a small engineering company and its network. More precisely we aim at tracing the decisions that has brought this company and its network to be active on the Chinese market. The theoretical frame of understanding summarised a selective literature review that draws on strategy as practice literature. Using an SAP lens - through an empirical case study - allowed the research team to closely study the rationales and decision processes followed by the actors as they occur and not as they are planned. Rasche and Chia (2009) suggest that SAP perspectives should complement traditional interviews and documentary analysis with ethnographic observation. The method to gather information is therefore multidisciplinary and employs an interpretive approach to discuss the empirical material (Bryman and Bell 2011). The empirical material presents a longitudinal case study (2014-2016) and draws on several complementary sources: An exploratory study including observation of three steering meetings of the project network, (between 2014-2015), 22 semi-structured interviews with members of the project, complemented by two interviews with two projects managers in larger companies. These interviews were semi-structured and follow guiding themes. They lasted between one and two hours and were recorded and were partially performed by master students guided by the authors. To validate the study, the results have been presented and discussed in a workshop gathering around 30 practitioners including five members of the network.

The choice of the case study is opportunistic and convenient. Part of a research network bridging academia and practitioners, we met two members of KarlssonCo, a

40 employee engineering company working with sustainable energy solutions, who had ambition to conquer the Chinese market (KarlssonCo is a pseudonym).

Internationalisation strategy at KarlssonCo

The initiation of the internationalization process is actually the result of a misunderstanding. One of KarlssonCo's engineers, Olsson (a pseudonym), was contacted by an architect who listened to a presentation on a sustainable solution KarlssonCo had developed for a local school. During the presentation, it was mentioned that KarlssonCo had three branch offices in Sweden one of them situated in Kinna. The confusion between Kinna, 30 kilometres from Gothenburg (Sweden) and China is appealing only for Swedes as Ki is pronounced Chi in Swedish. By the time they realise their mistake, Olsson had already been convinced to join the architect to a sustainable construction fair organised in China. As the cost of traveling was quite low, the engineer got his trip approved by the company board with the goal to explore the Chinese business potential for KarlssonCo. The company KarlssonCo had not expressed the wish to expand to overseas markets before, and never considered the Chinese market. But it was for this engineer "an opportunity I could not miss and I would do it again if I had the chance" (Olsson).

During the trip to China, contacts were made with a few companies in particular a Chinese sustainable architect company Jiànzhú shī (pseudonym, Chinese for architect) Besides, Olsson carried a small complimentary investigation to solve a technical problem regarding ventilation for a Chinese Company part of the Jiànzhú shī network and also related to a HVAC company, called Guǎn here (pseudonym Chinese for pipe), presenting them with three alternative solutions. A year later, convinced by the quality of the proposal, a small delegation composed of Jiànzhú shī and Guǎn managers came for a two-week' visit to Gothenburg. One of KarlssonCo engineers was Chinese and she was directly associated to the project, however more for her language skills than her professional competences; explaining partially why she later left the company. In order to strengthen KarlssonCo's position, Olsson, invited two engineer colleagues to join the team, Andersson and Larsson as well as an architect specialised in Eco-building with whom he had previously worked in another project. Satisfied with KarlssonCo's innovative proposal, the Jiànzhú shī decided to hire KarlssonCo to make some pre-studies.

At this point, KarlssonCo started to gather information about work collaboration with China. Building on their local network they collected advice from companies who had carried out jobs for Chinese clients. This advice was not very encouraging, pointing out the difficulty among others to agree on the amount of work, the fees for specific tasks, and the final payment once the project delivered. As sceptical opinions were expressed within the company, KarlssonCo commissioned the West Sweden Chamber of Commerce to deliver a short investigation on their partners as well as an assessment of the real potential of exporting Swedish sustainable design to China. Though presenting explicitly the barriers and challenges this process would face, the report concluded with a real possibility of establishing a market. It also supplied KarlssonCo with short, medium and long term strategies for their establishment in China providing the company would establish an office in the country. These strategies, though offering a topic for a master thesis of engineering students were rapidly discarded by the small group working with China.

To maintain their freedom of movement and silence internal critic, the KarlssonCo Chinese project group looked for additional support to finance their project with China.

They applied for funding at the Swedish Agency for Economic and Regional Growth which is a national governmental agency tasked with promoting entrepreneurship and regional growth. They received subvention to create a network of sustainability interested companies in Gothenburg in order to better profile their competences on the Chinese market. The Chinese group developed then to a network, integrating companies belonging to their close network. Besides the Eco-architect, a larger consultancy company operating mainly in construction planning, project administration and maintenance, the Pingman joined the group; a larger architectural practice with among other experiences in green office and urban planning, AR., was also invited. The partners of both companies are long term friends of one of the KarlssonCo engineers. However neither of them were interested in growth per se, it was the novelty of the project which attracted them. The Pingman partner was openly not convinced of the business potential of the Chinese project, yet he enjoyed working with the group and had minimised the financial risk his company took in the project.

Besides working partners, the network also included institutional partners. One partner, supported by the City of Gothenburg, is supposed to increase national and international recognition of the Gothenburg region as a leader in environmental and sustainable development, offering services to public and private sectors who are facing environment-related challenges, primarily in the global market, and to regional companies seeking international business contacts, as well as Chalmers Technical University researchers.

The KarlssonCo group also had contact with the Centre for Environmental Technology (CENTEC) part of the Swedish Embassy in Beijing who they met during their first trip. This centre is promoting national environmental technology in China. The centre was keen on having them return to China to advertise Swedish sustainable solutions for the construction sector. Consequently, CENTEC invited the KarlssonCo group twice to participate in large sustainability oriented professional fairs and touring in large cities to meet both private and public clients.

Besides financing their travel, these trips also contributed to identify and develop new business proposals. Noticing a lot of mistakes in the new buildings during their visit, as well as an apparent lack of competences regarding site management and technical skills in the production phases, Andersson and Larsson considered providing education modules to contractors and architects in China focusing on the realisation of passive and zero energy houses. They contacted a professor at Gothenburg University (SE), also a member of their professional network, to discuss the realisation of these modules; however their application for public funding was unsuccessful and the project was abandoned.

Similarly, facing the lack of competences in managing the large system of infrastructures expressed by some administrative members in the large new cities they visited, they thought to develop education to help cities to organise and control these infrastructures. This suggestion however did not meet the support of the steering group of KarlssonCo.

The Chinese adventure has led to a few projects together with Jiànzhú shī focusing on, for instance, pre studies of energy saving solutions for a hotel, a student house and a

forest tourist centre. The size of the projects has varied between 40 000 - 450 000 SEK. And final payment has indeed been an issue.

According to one of KarlssonCo's Chinese group members, the network is now concentrating on the design of green energy solutions for housing and offices. As they lack knowledge regarding Chinese building codes and regulations, they produced the pre-studies which are handed over to Jiànzhú shī engineers who finalise the drawings. The bigger project so far is their participation to design the first office building with passive house technology in Harbin, China.

ANALYSIS

The analysis looks at some selected themes derived from the study. First, we discuss the character of decision processes, followed by the limited information of the market, the choice of partners and finally the role of projects in the involved companies' strategy.

Decision processes

The case study illustrates very clearly that new projects at KarlssonCo are not created to concretise strategy or planned goals. On the contrary, it is the unplanned reaction to an opportunity which is initiating the project. The prospect of visiting China for the first time and to look at how environmental issues are dealt with, a topic he is genuinely interested in, is intriguing enough for Olsson to accept the proposition; at this point the goal to explore the Chinese market is nothing but a vague justification for his travel. This approach, taking an unexpected opportunity to launch new activities has often been described in the internationalisation of SME literature (Child and Hsieh, 2014). Usually, however, it is associated to the leading decision maker, not to the project manager (Schweizer 2012).

Once the opportunities have been created during the China trip, Olsson is defining their first project. Building on his usual practices on answering clients' demands and tenders, he constitutes the project around the Jiànzhú shī demands. Both the technical as well as the partners' solutions which he has gathered for the proposal, are chosen to fit the particular conditions. Dealing with uncertainties, Olsson assembled a group of people from his close network whom he trusts and has cooperated with before. The goal is to obtain a project from the Chinese connection, he is keen on working with. The introduction of the two KarlssonCo colleagues also diversified the content of the project, as they take a more active role in the process. The scope of the project moves from a technical solutions focus to a broader agenda including education, networking, and political influence.

As we follow the network, new goals are associated to the project, triggered by identified problems as they appear concretely in the field during the trips to China. A market study is contracted to the West Sweden Chamber of Commerce. But the report on this market study is not so much aimed at assessing the business potential of the Chinese project as to tranquilise the others members of the company, the CEO included.

The growing of the network is also understood as a necessity to strengthen the offer for the Chinese clients. By adding new companies, they add new competences to their problem solving strategies. None of the new companies is building on strategic consideration to join the network: curiosity and acquaintanceship are the motor of this association.

Limited information about the market
The members of the active network try neither to rationalise their participation in terms of business potentials or strategic moves, nor to measure the possible benefits they could obtain. They do not try to map the sector and assess their potential competitors. During the steering meeting they describe Stockholm region as their biggest competitor but this connects to the repartition of the Swedish market not the internationalisation project. Once again, going back to the common understanding of the market as it functions in their everyday practice.

During their two first trips to China, the two KarlssonCo members are confronted with their international competitors as portrayed by their local clients. They are surprised to find out that they have been in competition with other companies from European countries such as France or Germany. But what really shocked them is to be told that "Italian engineering companies are at the front of environmental driven companies!", as they take for granted that Italians are nobody in the green business" since they have never heard of them" (Larsson). However, they don't try to find out if the Italians' reputation is justified.

The choice of partners
The choice of the international partners has been coincidental in the Chinese project. When Olsson travels to China he has neither asked nor searched for information about potential partners, clients or projects that could fit with the competences his company provides. Though trusting the architect who has invited him, he is setting no goals to his travel. The meetings with Guǎn and Jiànzhú shī are somewhat accidental and their common interest for environmental sustainability as well as the unexpected help Olsson provides to their ventilation issues, initiates their collaboration.

Even if Andersson and Olsson meet numerous potential partners and clients during their two next travels to China, Guǎn and in particular Jiànzhú shī remain their main interlocutors in China.

We have asked other partners of the network, who carry other international activities, how they determine possible partners when planning a project abroad. Pingman is taking projects outside Sweden only to answer the demands of their Swedish clients. So when they screen a foreign market, it is not to find new projects but to realise the projects of their clients. They act as construction advisor/client counsellor for a few large manufacturing companies, monitoring the establishment of new factories. These turnkey projects cover the whole process from finding a suitable location, to choosing the contractors and controlling the properly functioning features of the finalised property. Since they have performed a number of these projects, they work with standardised requirements. Pingman is currently running similar constructions in US, Czech Republic and India. Two engineers, a senior and a junior employed in the company for the last 5 years, are in charge of managing these.

The interviews with Pingman reveal a more systematic search process to find partners: First they rely on their professional network, then on other Swedish companies active in the target location, or on embassies and supportive institutions such as CENTEC, but they recognised that google is actually quite efficient to find relevant partners. Once identified on the internet, these potential suppliers are contacted and invited to a bidding process. They judge the companies according to their answers to the brief and invite the chosen candidates for a final negotiation in Gothenburg where the contract is signed. It can be speculated that the company here draws on a high trust culture from the Swedish construction sector context, as studies from other countries have

shown far more cautious partner search processes (Bresnen and Marshall 2000). This has however not been investigated in this study.

A project is a project is a project

In the account of the company actors there seems to be little difference between the KarlssonCo Chinese group engaging in an internationalisation project and their business as usual when bidding or responding to their clients' demands on the local or national market. These engineers are used to not systematically obtain the projects they apply for. There is an element of risk whenever they answer a public tender that they are ready to take, it being in Gothenburg or in China.

This illustrates how existing practices, developed on the basis of the Swedish market are transformed into new similar praxises when operating on the Chinese market. This is in line with one source of strategy in SAP: the internal practices. Which is in line with one source of strategy in SAP; internal practices (the other being external practices such as strategy concepts). The project managers draw on their usual project development process, and new steps into a new market are legitimized by the project framing, causing these strategic moves to appear as business as usual. Perhaps one way to distinguish between these everyday routines and strategizing can be find in Oral and Jarzabkowski (2016) notion of managers "learning to live with it" as a response to strategizing occurring in a company. However, these project managers are, even if praxises build on previous practice, actively adopting new strategic opportunities and experimenting under the resource regime a small company operates under (Achtenhagen *et al* 2013). Importantly, in doing so they disregard the (external) tools defined by strategic models and reverse the strategy logic by focusing first on the implementations and building consequently the goals and the legitimation of the projects. Importantly in doing so they disregard the (external) tools defined by strategic models and reverse the strategy logic by focusing first on the implementations and building consequently the goals and the legitimation of the projects.

Would it be better to rely on rational strategy planning instead of building on opportunism and what appears to be intuitional decision processes? What seems to be at the first sight naïve and intuitive is actually the result of having carried out a large number of projects. Our network takes quick and often efficient decisions regarding the available possibilities. The project managers show flexibility, creativity and to a minor degree efficiency. In doing so, they contribute to the development of the company. If the Chinese project has not generated a large profit, it has certainly not increased the company deficit. Besides the formal contracts with the Chinese clients, this initiative has also generated increasing interest for KarlssonCo and its partners on the local and national market, as their collaboration with China has been covered by the local and professional media.

This observation is moreover not only valid for SMEs. Drawing on processual (SAP) studies of strategizing in large companies one can find similar transformations of existing practices (Koch & Friis 2015).

Project managers as strategy practitioners

The study features senior project managers in the role of central strategy practitioners. They transform Swedish practices into new praxises for the Chinese market. This occurs under the framing of a strategy development which is focused on the Swedish market. Strategizing in our case company occurs in both internal and external arenas that relaxes ordinary assumed hierarchy of management positions: top managers,

middle managers and project managers. Rather this strategic orientation, strategizing, is shared within these liminal arenas where several types of managers contribute to new developments.

Project managers are rarely discussed in the SAP literature, where recurrent strategists are higher level managers (Jarzabkowski and Spee 2009, Vaara and Whittington 2012). But the result can be compared to Koch *et al*., (2015) and Sage *et al*., (2012) cases of project and middle managers in contractor firms acting as strategy practitioners. The project managers in our case act as strategists. They have close contact to the company management and do not have to strategize for years as in Koch and Friis (2015) discussing a large contractor. However, we would argue that such closeness between a corporate management group and project managers representing the "strategic end" of projects may not be so unusual in larger project based companies.

CONCLUSION

Building on the SAP lens has enabled us to observe how an internationalisation process was unfolding in a local network of small engineering companies. Following the project managers' activities underlines how their practices refer to mostly internal but also to external routines, discourses, concepts, recipes, which can be used in strategizing. In doing so, their activities clearly depart from conventional understanding of internationalisation strategy as they draw on their working habit of developing specific solutions for their customers' demands or needs. The study shows that this approach is actually quite agile and appropriate for the company. It thereby breaks with many mainstream classical strategic models, while supporting those that find strategy processes as being anarchic and emergent.

References

Achtenhagen, L, Melin, L and Naldi, L (2013) Dynamics of business models - strategizing, critical capabilities and activities for sustained value creation. *Long Range Planning*, **46**(6), 427-442.

Bresnen, M and Marshall, N (2000) Building partnerships: Case studies of client-contractor collaboration in the UK construction industry. *Construction Management and Economics*, **18**(7), 819-832.

Bryman, A, and Bell, E (2015) *Business Research Methods*. New York: Oxford University Press.

Child, J and Hsieh, L H (2014) Decision mode, information and network attachment in the internationalization of SMEs: A configurational and contingency analysis. *Journal of World Business*, **49**(4), 598-610.

Friis O (2012) Strategy-as-Practice - Involving Employees. PhD Thesis, Aarhus University, Herning, Hodgkinson.

Hammarström M, Engwall M, and Lagergren F (2012) *Ledningsutmaningar i konsultföretag - En studie av företagsledningarnas utmaningar i teknikbaserade konsultföretag på den svenska marknaden*. Stockholm, Royal Institute of Technology (Management challenges in consulting companies).

Hodgkinson, G P, Whittington, R, Johnson, G and Schwarz, M (2006) The role of strategy workshops in strategy development processes: Formality, communication, co-ordination and inclusion. *Long Range Planning*, **39**(5), 479-496.

Jarzabkowski, P and Spee, A P (2009) Strategy-as-practice: A review and future directions for the field. *International Journal of Management Reviews*, **11**(1), 69-95.

Kim, W C and Mauborgne, R (2005) Blue ocean strategy: From theory to practice. *California Management Review*, **47**(3), 105-121.

Koch C and Friis O (2015) Operation strategy development in project-based production: A political process perspective. *Journal of Manufacturing Technology Management*, **26**(4), 501-514.

Koch C, Sage D, Dainty, D and Simonsen, R (2015) Understanding operations strategizing in project-based organisations: Middle managers' interaction and strategy praxis. *Engineering Project Organisation Journal*, **5**(2-3), 106-117.

Löwstedt, M (2015) *Strategizing in Construction: Exploring Practices and Paradoxes*. PhD Thesis, Construction Management, Chalmers University of Technology.

Mintzberg, H and Lampel, J (1999) Reflecting on the strategy process. *Sloan Management Review*, **40**(3), 21-30.

Mintzberg, H Ahlstrand, B and Lampel, J (1998) *Strategy Safari: A Guided Tour through the Wilds of Strategic Management*. New York: Free Press.

Nordqvist, M (2012) Understanding strategy processes in family firms: Exploring the roles of actors and arenas. *International Small Business Journal*, **30**, 24-40.

Porter, M E (1985) *Competitive Advantage*. New York: The Free Press.

Oral C and Jarzabkowski, P (2016) How practitioners learn to strategize: a performative view. Paper submitted to the *32nd EGOS Colloquium; Sub-theme 70 - Strategy practices and performativity: Understanding strategy as performative practice*. Naples.

Rasche, A and Chia, R (2009) Researching strategy practices: A genealogical social theory perspective. Organization studies, **30**(7), 713-734

Rouleau L (2013) Strategy-as-practice research at a crossroads. *M@n@gement*, **16**(5), 547-565.

Sage, D, Dainty, A and Brookes, N (2012) A 'Strategy-as-Practice' exploration of lean construction strategizing. *Building Research and Information*, **40**(2), 221-30.

Schweizer, R (2012) The internationalization process of SMEs: A muddling-through process. *Journal of Business Research*, **65**(6), 745-751.

Thuesen C, Koch C and Nielsen J (2010) Strategy and business development practices in Danish construction industry SMEs. *In*: C Egbu (Ed.) *Proceedings 26th Annual ARCOM Conference*, 6-8 September 2010, Leeds, UK. Association of Researchers in Construction Management, Vol. 2, 919-28.

Vaara, E and Whittington, R (2012) Strategy-as-practice: Taking social practices seriously. *The Academy of Management Annals*, **6**(1), 285-336.

Wandahl, S and Ussing, L (2010) Strategy development in small and medium contractors in the light of the financial crisis. *In*: *Proceedings: Papers And Postgraduate Papers From The Special Track Held At The CIB World Building Congress 2010*, 10-13 May 2010 The Lowry, Salford Quays, UK, 1-11.

Whittington, R (2006) Completing the practice turn is strategy research. *Organization Studies*, **27**(5), 613-634.

SUSTAINABILITY

SDG2030: A SUSTAINABLE BUILT ENVIRONMENT'S ROLE IN ACHIEVING THE POST-2015 UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS

Alex Opoku[1]

Bartlett School of Construction and Project Management, University College London, Faculty of the Built Environment, 2nd Floor 1-19 Torrington Place, London, WC1E 7HB, UK

In September 2015, the 193 UN member states adopted the new Sustainable Development Goals (SDGs) consisting of 17 goals, supported by 169 targets and underpinned by 100 global indicators. Delivering a Sustainable Built Environment (SBE) is vital in achieving the SDGs due to the impact of the built environment in achieving society's sustainable development agenda. The built environment can be central to the delivery of policies for sustainable development through the adoption of environmentally friendly design, procurement, construction methods and management practices towards the delivery of buildings and infrastructure. This paper presents preliminary findings of an exploratory study aimed at examining the role/impact of a SBE towards achieving the post-2015 SDGs. The study adopts a qualitative research approach that examines the role/impact of a SBE in achieving the SDGs through participatory research methodology. The focus group interactive workshop consisted of 8 academics and practitioners. The findings indicate that a SBE can significantly contribute to socio-economic development and well-being. The provision of smart cities and sustainable communities, sustainable design and construction of infrastructure and the provision of renewable energy technology such as solar on built assets are some of the role a SBE can play towards the attainment of the SGDs.

Keywords: built environment, sustainable development, sustainable development goals, SDG2030

INTRODUCTION

The adoption of the Sustainable Development Goals (SDGs) by the UN in 2015 marked a crucial moment for the global development agenda. The SDGs has been described as a "plan of action for people, planet and prosperity" (UN, 2015). The next generation development framework represents a paradigm shift towards socio-economic development. The 2030 agenda for sustainable development which comprises 17 goals, 169 targets and about 100 indicators represent a new direction for the global community (IRF, 2015). The new SDGs and the broader sustainability agenda addresses significant universal challenges to sustainable development that the Millennium Development Goals (MDGs) ignored such as environmental degradation, inequality, weak institutional capacity and unsustainable consumption behaviour in society(ICSU and ISSC, 2015). Unlike the MDGs, the SDGs are concise, easy to communicate and action-oriented (Sachs, 2012). Strandenaes (2015) however describe the SDGs as universal, integrated, interlinked, inseparable, planet-sensitive and

[1] a.opoku@ucl.ac.uk

Opoku, A (2016) SDG2030: A Sustainable Built Environment's Role in Achieving the Post-2015 United Nations Sustainable Development Goals. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1101-1110.

centred around people. The SDGs which reflect a global agenda towards socio-economic development is underpinned by governance and set out ambitious objectives covering the three sustainable development dimensions of economic development, social inclusion, and environmental sustainability (IRF, 2015; Sachs et al., 2016).

SDGs incorporate all the dimensions of sustainable development in a balanced and interlinked manner (UNEP, 2013) offering better understanding of the relationship between social, economic and environmental dimensions of sustainability (Glaser, 2012). The next part of the paper provides literature review on the SDGs, sustainable built environment and the impact a sustainable built environment towards achieving the SDGs. The third part presents the adopted research methodology, data collection method and analysis. The final part presents research findings and conclusions.

Whiles SBE and SDGs are two broad topic areas; this paper only presents preliminary findings of an ongoing study aimed at examining the role/impact a SBE can have in achieving the post-2015 UN SDGs by 2030. The limitations to this paper are that, the SDGs were agreed only in September 2015 and therefore little or nothing has been written about the link between SBE and SDGs. In addition, this exploratory study involves only 8 participants in a participatory focus group style workshop.

Sustainable Development Goals (SDGs)

The increasing determination of society to achieve sustainable development for all has been an influential factor for governments signing up to the 2030 agenda for sustainable development (Sachs, 2012). The SDGs has been described as the 'five Ps' plan of action for people, planet, prosperity, peace, and partnership. The goals will ensure that all people can achieve their full potential with pride and fairness and in a healthy environment (People); by taking serious actions on climate change to protect the planet from degradation (Planet); ensuring that all people can enjoy prosperous and rewarding lives (Prosperity); foster a society that is peaceful, just and inclusive (Peace) through global partnership and solidarity with all stakeholders (partnership) for sustainable development (UN, 2015).

At the heart of the new global development goals for the next 15 years aims at improving prosperity and wellbeing until 2030 by addressing the economic, social and environmental challenges that society faces today (Griggs et al., 2015; IRF, 2015). These transformational goals are universally applicable to all countries and tackle the challenges of eliminating extreme poverty, safeguarding environmental sustainability while achieving economic and social wellbeing. It also takes into account different realities, capacities and levels of development of various countries (UNEP, 2013). The MDGs targeted the poor and emerging nations but the SDGs is applicable to both developed and developing countries (Glaser, 2012). The 17 post-2015 United Nations SDGs are presented in Table 1. Vergragt and Quist (2011) believe that strategies, plans and process towards achieving the SDGs should be a multi-stakeholder process at both national and local government levels involving civil society, businesses, faith-based groups and academia.

Sustainable built environment

Achieving a more sustainable society requires the redefinition of the relationship between the built and natural environments. The built environment consumes lots of energy and resources whiles generating large amount of waste. The solution to this challenge is the design and construction of improved built asset supported by

appropriate management tools and regulatory frameworks that addresses sustainable development issues (Grierson, 2009). The built environment is literally a hub of economic activities, individuals and families, as well as society's cultural heritage.

Table 1: The 17 Sustainable Development Goals (SDGs)

Goal 1	End poverty in all its forms everywhere
Goal 2	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
Goal 3	Ensure healthy lives and promote well-being for all at all ages
Goal 4	Ensure inclusive and equitable quality education and promote life-long learning opportunities for all
Goal 5	Achieve gender equality and empower all women and girls
Goal 6	Ensure availability and sustainable management of water and sanitation for all
Goal 7	Ensure access to affordable, reliable, sustainable and modern energy for all
Goal 8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
Goal 9	Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation
Goal 10	Reduce inequality within and among countries
Goal 11	Make cities and human settlements inclusive, safe, resilient and sustainable
Goal 12	Ensure sustainable consumption and production patterns
Goal 13	Take urgent action to combat climate change and its impacts
Goal 14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
Goal 15	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
Goal 16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
Goal 17	Strengthen the means of implementation and revitalise the global partnership for sustainable development.

Adapted from (UN, 2015)

The built environment host economic activities, protects life and health, psychological and social welfare of its inhabitants, and sustain aesthetic and cultural values (Holm, 2003). The built environment involves human and cultural issues (why people build), environmental issues (natural and built context) and technological issues (materials, energy and financial resources, methods, and systems required to establish interrelationships and construct the built environment (Bartuska, 2007). Building for sustainable development involves using design and construction methods and practices, which strive for integral quality (including economic, social and environmental performance) in a very broad (or holistic) way (Grierson, 2009). Halsall (2011) explains that, the built environment is the physical human created surroundings such as roads, bridges, and building structures, contrasting that of the natural environment. The connections between components of the built environment, such as individual buildings, transport systems, urban landscapes and other

infrastructure are important. A sustainable built environment should aim at reducing environmental impacts in terms of energy, carbon, waste or water; this will involve creating a built environment that produces more than it consumes with environmental, social, cultural and economic benefits (Jenkin and Pedersen, 2009). Organizations can contribute to achieving sustainability by reducing their negative impact on the natural environment while increasing the whole life of built asset in the built environment (Poston et al., 2010). The conservation of historic cities is an effective strategy in reducing CO2 emissions when compared to their replacement by new buildings. New construction projects have more damaging impacts in short to mid-term; however conserving an existing building saves original energy and CO2 investment (Lewis, 2012).

Sustainable development goals and the built environment

Sustainable infrastructural development contributes to economic growth which in turn stimulates activities in other sectors of the economy (Lopes, et al., 2011; Dahiru and Mohammed, 2012). The built environment has a long-term impact on quality of life, prosperity, health, wellbeing and happiness of people and communities in terms of how planning, design, management and maintenance of the built asset (House of Lords, 2016). It is estimated that greenhouse gas emissions will rise to about 37% in 2030 compared to 2005 levels affecting the natural and the built environment if efficient policies are not implemented (OECD, 2008). Creating a sustainable built environment, through design, construction and management, enables all people to live well, within environmental limits. Built environment also needs to be flexible and adaptable to future uses, and be resilient to cope with local effects of climate change. Governments spending on infrastructure will enhance economic growth and delivery of essential services including the supply of clean water to the people (Nguyen and Culbard, 2014).

A SBE is becoming more important due to the growing impact of the built environment in achieving society's sustainable development. A sustainable built environment adopts design, construction methods and practices that make use of local expertise and experience (Grierson, 2009). According to a report by the House of Lords Select Committee on National Policy for the Built Environment, the climate change challenge can be responded to with a more holistic approach to built-environment issues by all stakeholders with emphasis on planning, landscape, architecture, conservation and engineering; planning system can play an important role in shaping our built environment (House of Lords, 2016)

Nguyen and Culbard (2014) add that failing to address global infrastructure needs will potentially reverse some of the positive gains from the MDGs and compromise the future of the SDGs. Sustainably planned and designed building development projects and urbanisation can improve land use, reduce resource consumption and improved congestion. This can positively impact on people, communities, local and national economies. Sustainable buildings and regeneration projects can also significantly contribute to social well-being (Wilson, 2015). Policies toward a SBE where individuals can live well and contribute positively in developing a sustainable socio-economic society should be a priority for policy makers (House of Lords, 2016). Infrastructure includes physical assets such as roads and bridges as well as the delivery of sustainable solutions for reliable energy, clean water, communications, logistics and mobility. It is estimated that about 60% of the world's population will live in urban areas by 2030 and this will be rapid in developing countries where there

is no infrastructure to support services such as clean water and sanitation (OECD, 2008). It is therefore important that the development of sustainable infrastructure and facilities that are resilient to possible environmental risk, sustainable in its construction and use that allows successful operation of business and services could enhance the efforts towards achieving the SDGs (Wilson, 2015). Achieving a sustainable built environment will impact on the society's ability towards the realisation of the SDGs. The construction industry is central to the delivery of many of the Government's policies for sustainable development through the provision of buildings, infrastructural development or contaminated land reclamation.

METHODOLOGY

This paper adopts the interpretivist/constructivist philosophical stance that argues that reality can fully be understood only through the subjective interpretation and intervention in reality (Creswell, 2003). The constructivist researcher is most likely to rely on qualitative data collection methods and analysis (Mackenzie and Knipe, 2006). In the qualitative research paradigm, the most important focus is for researchers to capture accurately the existing experiences and perceptions of participants involved in the phenomenon or process under investigation (Onwuegbuzie and Johnson, 2006). Qualitative method is concerned with words and images out of which the researcher seeks to interpret meanings and explanations as to the way people behave and to develop an understanding of social constructs. This study therefore adopts a qualitative research approach for data collection and analysis. Qualitative data was collected through participatory research methodology reflecting and exploring the experiences of research participants (Swain and French, 2004) and support the involvement of research stakeholders in the knowledge-production process (Bergold, 2007). It is about conducting research with and for the research subjects; research with the people rather than on the people.

Nothing has been written on the link between SBE and the new UN post-2015 SDGs in literature and therefore the adoption of qualitative data collection method is the most appropriate to capture relevant data and information for the study. In addition, the phenomena under investigation (SDGs and the SBE) are people-centred and therefore the adoption of participatory research methodology where the research stakeholders participate in the co-production of knowledge with the purpose of understanding social reality from the people's perspectives is justified.

The interactive focus group workshop consisting of two group of four members each facilitated by the researcher discussed the role of a SBE in achieving the SDGs. There were 5 academics and 3 practitioners from the UK construction industry selected through purposeful sampling. Invitations were sent to 12 potential participants but 8 accepted to take part in the study. Participants were selected on the basis of their expertise in sustainable development and the built environment. The workshop aimed at obtaining detailed information, perceptions and opinions from participants on the role/impact a SBE can have in achieving the SDGs. The one-day interactive focus group workshop discussed their understanding of SBE followed by a discussion of the link between SBE and each of the 17 SDGs. The ice-breaker for the participatory workshop was to discuss and establish participants understanding of SBE before linking that to how SBE can impact on achieving the SDGs.

DATA ANALYSIS AND DISCUSSION

This exploratory study aims at examining the role/impact of a SBE in achieving the SDGs. To achieve the research aim, qualitative data was collected through interactive focus group workshop made up of 8 participants; 5 academics and 3practitioners. The qualitative data were analysed by transcribing, identifying and coding the themes, interpreting and providing an explanatory accounts through content analysis. To examine the link between SBE and SDGs, the 17 SDGs were translated into four groups based on the level of impact/influence a SBE can have on each of the SDGs. The agreed impact levels were; High, Medium, low or no impact. The workshop team agreed that sustainable development Goal 3 (good health & well-being), Goal 6 (clean water & sanitation), Goal 7 (affordable & clean energy), Goal 9 (innovation & infrastructure) and Goal 11(sustainable cities & communities) will be impacted significantly by the delivery of a SBE. However a SBE will have a medium level of impact on Goals 1, 2, 4, 8 and 13; with low impact on Goals 5, 10, 12, 15, 16, and 17. The analysis of the goals identified the intertwined and the inter-linked nature of the SDGs as found in literature. For example Goal 11 which is about sustainable cities and communities is linked to Goal 6 (clean water and sanitation), Goal 8 (sustainable economic growth) and Goal 10 (reducing inequality).

The qualitative data from the interactive participatory discussion workshop showed that a SBE has a role to play towards achieving the SDGs. Delivering a SBE will influence society's ability to realise the new SDGs. The workshop participants worked in groups working through all the 17 SDGs to explore the role a SBE can play in achieving them by 2030. A summary of the findings is presented in Table 2. In order for the global community to achieve these ambitious SDGs, a fundamental change in the way society thinks and acts is needed. Developing a SBE can contribute greatly towards the global efforts of achieving the SDGs by the year 2030. Governments are one the major clients with the economic power to drive the adoption of sustainable practices by demanding sustainable built assets. The built environment can support the achievement of Goal 3 by delivering sustainable health facilities which can impact positively on the well-being of people. The design, construction and the provision of environmentally friendly and affordable housing for all can also support the above goal. The built environment role in achieving Goal 6 can be through the design, construction and management of facilities that support efficient water use and improved sanitation whiles the introduction of renewable energy technology such as solar on both new build and refurbished building can support Goal 7. A SBE is critical if Goals 9 and 11are to be achieved; the procurement, design and construction of infrastructural projects that addresses the triple bottom line of social(people), economic(profit) and environmental(planet) is key to the realisation of SDGs.

In respect of Goal 11; cities, communities and all places of human settlement should be made inclusive, safe, resilient and sustainable. The built environment should provide affordable housing for the poor and the disadvantage in the society as part of efforts towards achieving Goal 1. Also the construction industry provides employment opportunities for the unemployed people in the communities where built asset projects are undertaken to help eradicate poverty and improve people's standard of living. A sustainable built environment can play a role towards achieving Goal 2 through employment opportunities for local companies' involved in infrastructural projects for farming irrigation and food storage. In terms of Goal 4, training opportunities on employable and sustainable literacy skills can be provided to people to ensure the sustainable design, procurement and construction of educational facilities. Investment

in infrastructural projects will generate employment serving as a driver for economic growth in supporting Goal 8.

Table 2: SBE Role/impact in achieving the SDGs

Goal No.	Description	Role of sustainable Built Environment
Goal 1	No Poverty	Employment opportunities for communities where project are undertaken
Goal 2	Zero Hunger	Develop infrastructure for irrigation projects and food storage
		Employment opportunities for local companies
Goal 3	Good health & well-being	Deliver sustainable health facilities
		Provision of improved & affordable housing for all
Goal 4	Quality Education	Training opportunities on employable skills
		Sustainable design, procurement and construction of educational facilities
Goal 5	Gender Equality	Encouraging women to work on the operation and maintenance of built assets
Goal 6	Clean water & sanitation	Design and construct facilities that support efficient water & sanitation
Goal 7	Affordable and clean energy	Introduce renewable energy technology such as solar on built assets
Goal 8	Decent work and Economic Growth	Investment in infrastructure as a driver for economic growth
		Employment opportunities through SBE projects
Goal 9	Industry, innovation & infrastructure	Design and construction of sustainable infrastructure
		Retrofitting existing built assets to incorporate smart technology
Goal 10	Reduced inequalities	Ensure health safety and well-being of people on built environment projects
		Financial support for developing countries in infrastructural projects
Goal 11	Sustainable cities & communities	Developing smart and sustainable cities
		Development of Resilient communities
Goal 12	Responsible consumption and production	Sustainable use of constructed assets
		Conservation of historic cities instead of building new ones
Goal 13	Climate action	Design and construct resilient infrastructure that can withstand the challenges of climate change
		Develop planning policies that will deliver SBE to mitigate the risk of climate change
Goal 14	Life below water (Oceans)	**
Goal 15	Life on land (biodiversity)	Manage environmental impact of construction process
		Encourage the use of FSC certified timber on built environment projects
Goal 16	Peace, justice & strong institution	Social impact assessment on infrastructural projects
		Sustainable regeneration of crime/deprived communities
Goal 17	Partnership for the goals	Use the provision of a sustainable built environment (bridges, roads etc.) in developing countries as a driver for global partnership for sustainable development

**-No impact

In tackling the effects of climate change (Goal 13), the design and construction of resilient infrastructure that can withstand the challenges of climate change can be

achieved by the introduction of the relevant planning policies that will deliver a SBE that mitigate the risk of climate change.

Even where the impact of a SBE on the SDGs is low (Goals 5, 10,12, 15, 16, 17), the built environment should encouraging women and minority to work on the operation and maintenance of built assets; improving the health, safety and well-being of people involved in the delivery of built assets; promoting the conservation of historic cities instead of demolition and building new ones; ensuring that every timber used on construction projects are FSC certified and using regeneration projects a catalyst for change in deprived communities.

CONCLUSION

The UN post-2015 agenda for sustainable development represent a new direction for the global community, integrating social, economic and environmental sustainability into all policies and strategies with the view of eliminating poverty and inequality to achieve a more prosperous society. The preliminary findings from this exploratory study show that a SBE has a critical role to play in a achieving the SDGs; preserving the planet whiles providing prosperity for the people. The qualitative data reveals that developing smart cities and sustainable communities, sustainable procurement, design and construction of infrastructure, and the provision of renewable energy technology such as solar on built assets are some of the roles a SBE can play in achieving the SDGs. The built environment has much impact on some of the roles than others. For example, a SBE could highly influence the realisation of Goals 11(sustainable cities & communities), 9(Infrastructure &Innovation) and 7(affordable & clean energy). The construction industry is a key partner in the global effort to achieve sustainable development by 2030 through the development of sustainable infrastructural projects especially in developing countries. Therefore the built environment can act as a driver for realising the SDGs backed by right government policies and strategies. In this regard, governments across the globe should use the construction industry as champions to develop SBE through the provision of the right policies and regulations. As part of the ongoing study, additional data collection is to be collected to enrich and validate these preliminary findings. The study could impact on policy direction for various governments in using the built environment as a driver for achieving the SDGs.

REFERENCES

Bartuska, T J (2007) The built environment: Definition and scope. *In*: W R McClure and T J Bartuska (Eds.) *The Built Environment: A Collaborative Inquiry Into Design And Planning, 2nd Edition*. Abingdon, Oxon: John Wiley & Sons, 3-14.

Bergold, J (2007) Participatory strategies in community psychology research: A short survey. *In*: A Bokszczanin (Ed.) *Poland welcomes community psychology: Proceedings from the 6th European Conference on Community Psychology*. Opole: Opole University Press, 57-66.

Creswell, J W (2003) *Research Design: Qualitative, Quantitative, and Mixed Methods Approach 2nd Edition*. Thousand Oaks, CA: Sage Publications.

ICSU and ISSC (2015) *Review of the Sustainable Development Goals: The Science Perspective*. Paris: International Council for Science (ICSU)/International Social Science Council (ISSC).

Dahiru, A and Mohammed, I Y (2012) The roles of researchers in the construction sector: Towards achieving the millennium development goals. *Journal of Science and Multidisciplinary Research*, **4**, 80-93.

Glaser, G (2012) Policy: Base sustainable development goals on science, *Nature*, **491**, 35.

Grierson, D (2009) *Towards a Sustainable Built Environment*. CIC Start Online Innovation Review, **1**, 70-77.

Griggs, D, Stafford Smith, M, Rockström, J, Ohman, M C, Gaffney, O, Glaser, G, Kanie, N, Noble, I, Steffen, W and Shyamsundar, P (2014) An integrated framework for sustainable development goals. *Ecology and Society*, **19**(4), 49.

Halsall, P (2011) Culture, sustainability and the built environment: Revisiting heritage and vernacular in economic decline. *The International Journal of Global Built Environment Review (GBER)*, **8**(1), 71-73.

Holm, F H (2003) Towards a sustainable built environment prepared for climate change? *Global Policy Summit on the Role of Performance-Based Building Regulations in Addressing Societal Expectations, International Policy, and Local Needs.* National Academy of Sciences, 3-5 November 2003. Washington, DC: USA.

House of Lords (2016) *Select Committee on National Policy for the Built Environment: Building better places; Report of Session 2015-16*. London: HMSO. Available from http://www.publications.parliament.uk/pa/ld201516/ldselect/ldbuilt/100/10002.htm [Accessed 8th March 2016]

Independent Research Forum (IRF) (2015) *Transforming the Course of Development Post-2015*. Independent Research Forum, Independent Research Forum for a post-2015 sustainable development agenda. Available from http://www.irf2015.org

Jenkin, S and Pedersen, M (2009) Rethinking our built environments: Towards a sustainable future. Wellington, New Zealand: Ministry for the Environment.

Lewis, J O (2012) *Renovate or Demolish/Rebuild: What are the Drivers?* EuroACE, Brussels, Renovate Europe Day, 11 October 2012. Available from http://renovate-europe.eu/wp-content/uploads/2015/09/RE-Newsletter-2012_3..pdf [Accessed 12th Dec 2013]

Lopes, J P, Oliveira, R A and Abreu, M I (2011) The construction industry and the challenges of the millennium development goals. *In*: *Proceedings of Management and Innovation for a Sustainable Built Environment*, 20 - 23 June 2011, Amsterdam, The Netherlands. The Netherlands: CIB/ Delft University of Technology.

Mackenzie, N and Knipe, S (2006) Research dilemmas: Paradigms, methods and methodology. *Issues in Educational Research*, 16(2), 193-205.

Nguyen, T and Culbard, L (2014) *Bechtel-U.S Council for International Business Submission to the United Nations Sustainable Development Goals*. London: Bechtel Corporation.

Organisation for Economic Co-operation and Development (2008) *OECD Environmental Outlook to 2030*. Paris: OECD Publishing.

Onwuegbuzie, A J and Johnson, R B (2006) The validity issue in mixed research. *Research in the Schools*, 13(1), 48-63.

Poston, A, Emmanuel, R and Thomson, C (2010) Developing holistic frameworks for the next generation of sustainability assessment methods for the built environment. *In*: C Egbu (Ed.) *Proceedings 26th Annual ARCOM Conference*, 6-8 September 2010, Leeds, UK. Association of Researchers in Construction Management, Vol. 2, 1487-96.

Sachs, J D (2012) From millennium development goals to sustainable development goals. *The Lancet*, **379**, 2206-2211. New York, NY: Earth Institute, Columbia University.

Sachs, J D, Schmidt-Traub, G and Durand-Delacre, D (2016) *Preliminary Sustainable Development Goal (SDG) Index and Dashboard, SDSN Working Paper*. Available from http://unsdsn.org/resources/publications/sdg-index/ [Accessed 20th March 2016]

Strandenaes, J-G (2015) The SDGs and HLPF: A new paradigm for civil society; A presentation for Vienna University of Economics and Business. *In*: *Proceedings of the international symposium held on 28th October 2015 at Vienna University of Economics and Business.* Austria: Vienna University of Economics and Business.

Swain, J and French, S (2004) Researching together: A participatory approach. *In*: S French and J Sim (Eds.) *Physiotherapy: A Psychosocial Approach 3rd Edition*. Oxford: Butterworth-Heinemann.

United Nations (2015) *Transforming our world by 2030: A new agenda for global action Zero*. Draft of the outcome document for the UN Summit to adopt the Post-2015 Development Agenda. New York: United Nations.

United Nations Environment Programme (UNEP) (2013) *Embedding the Environment in Sustainable Development Goals, UNEP Post-2015 Discussion Paper 1, Version 2*. Nairobi: United Nations Environment Programme.

Vergragt, P J and Quist, J (2011) Backcasting for Sustainability: Introduction to the Special Issue. *Technological Forecasting and Social Change*, **78**(5), 747-55. Available from http://www.tellus.org/pub/TFSC_Backcasting_for_Sustainability.pdf, accessed April 2016

Wilson, A (2015) *Sustainable Development Goal 11: Make Cities Safe and Sustainable*. Available from https://www.greenbiz.com/article/sustainable-development-goal-11-make-cities-and-human-settlements-inclusive-safe-and [Accessed 2nd April 2016]

SUSTAINABLE BUILDING IN SCANDINAVIA: DIRECTIONS OF INNOVATIONS FOR SUPPORTING THE TRANSITION

Nina Koch-Ørvad[1] and Christian Thuesen

Department of Management Engineering, Technical University of Denmark – DTU, Building 424, 2800 Kgs. Lyngby, Denmark

Buildings are essential for securing a sustainable society, and the Scandinavian building sector is viewed upon globally as the one to lead the way. This paper investigates in which directions sustainable building in Scandinavia is likely to move and outlines a number of areas where sustainable innovations are necessary for supporting this movement. The focus on innovations as essential support for the sustainable transition of the building sector derives from the Multi-Level Perspective, which has been applied to this study as a framework for understanding sustainable transitions of socio-technical systems. The findings are based on twelve expert interviews with key persons from central companies, research institutions and associations in Denmark, Norway and Sweden. The experts identify five directions for sustainable building in Scandinavia and list a number of innovations that will support the movement of the sector in these directions. These paths to the future for sustainable building seem remarkable clear and manageable, and the paper discusses the risk of the experts being too optimistic in their assessment of the sustainable transition of the Scandinavian building sector.

Keywords: sustainability, innovation, transition management, Scandinavia

INTRODUCTION

The building sector plays a central role in the global transition towards a more sustainable society (International Energy Agency 2013; Chalmers 2014). Around the world, governments, researchers and companies are looking at the Scandinavian[2] countries as frontrunners within the field of sustainable building (World Green Building Council 2013; Strand *et al*., 2014). Being the frontrunner, the Scandinavian building sector holds an interesting position, as development of the sector will mark the directions in which sustainable building in a global perspective is likely to move. Furthermore, innovations for supporting the movement of the Scandinavian building sector also hold the potential to cross borders and thus initiate an acceleration of the sustainable transition of building sectors globally. This paper aims to outline the areas in which practitioners and researchers should focus their innovation activities to support the sustainable transition of the Scandinavian building sector.

The particular focus of this paper on innovations as essential for the sustainable transition derives from the Multi-Level Perspective (Geels 2004; Geels and Schot

[1] ninko@dtu.dk

[2] In this paper, Scandinavia refers to Denmark, Norway and Sweden

Koch-Ørvad, N and Thuesen, C (2016) Sustainable Building in Scandinavia: Directions of Innovations for Supporting the Transition. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1111-1119.

2010; Schot and Geels 2008). The Multi-Level Perspective (MLP) provides a framework for understanding sustainable transitions of socio-technical systems (e.g. the building sector). MLP argues that transitions come about through innovation processes at three levels: socio-technical regimes, innovation niches and the overarching landscape (Geels 2004). This perspective, that sustainable transitions occur due to innovation processes, has scoped the study of this paper to focus on the innovations necessary for supporting the development of sustainable building in Scandinavia.

A considerable amount of literature has approached the topic of sustainable transition of the building sector (Rohracher 2001; O'Neill and Gibbs 2014; Zuo and Zhao 2014; Yong *et al*., 2011). A specific focus in the literature has been on drivers and barriers for sustainable building (Häkkinen and Belloni 2011; Bossink 2004) and innovation processes (Robinson *et al*., 2015; Berry *et al*., 2013; Shove 1998). However, current literature has only paid limited attention to the sustainable transition of the Scandinavian building sector. Specific aspects of sustainable building have been studied in the different countries, e.g., social sustainability in Sweden (Koch and Buser 2015), the role of house owners in Norway (Risholt and Berker 2013) and strategic spatial planning in Denmark (Quitzau *et al*., 2012). Based on twelve expert interviews with key persons from Denmark, Norway and Sweden, this paper contributes to the literature with a unifying, overall perspective on the transition process of the sustainable building sector in Scandinavia.

The structure of this paper is as follows: The first section unfolds the theoretical framework for understanding sustainable transitions, the Multi-Level Perspective. The second section describes the empirical methodology of the study, and the third section presents the findings from the expert interviews. The fourth and fifth sections discuss the findings and conclude the paper.

THEORETICAL FRAMEWORK

The Multi-Level Perspective (Geels 2004; Schot and Geels 2008; Geels and Schot 2010) offers a framework for understanding and investigating the sustainable transition of a socio-technical system. The Multi-Level Perspective (MLP) understands transitions as arising from the interaction between developments at three levels; the socio-technical regime, the innovation niches and the overarching landscape (Geels 2014).

The socio-technical regime, e.g. the building sector (Gibbs and O'Neill 2015), is characterised by a number of established practices and associated rules that secure a dynamical stable condition of the regime. Hence, the innovations within the regime are incremental and occur along specific trajectories, e.g. technology, policy and user practices (Geels and Schot 2010). Radical innovations, on the contrary, typically occur outside or on the border of existing regimes in so called innovation niches (Geels 2004). Niches are small-scale experimental spaces for new technologies (Kemp *et al*., 1998) and act as incubation rooms that protect innovations against the regime's mainstream conditions and traditional practices (Geels 2004). Regimes and niches are set within the broader context of the socio-technical landscape that includes macro-political developments, e.g. globalisation, urbanisation and environmental issues (Geels and Schot 2010).

The Multi-Level Perspective argues that innovations play a particular large role in the transition of a socio-technical regime: "They are the seeds of transition" (Geels and

Schot 2010, p.24). Some innovation activities at the niche level can over time become aligned and stable enough to challenge the dominant regime. However, innovations will often remain in niches for a long time until changes at the landscape level (e.g. the climate change agenda) create pressure on the existing regime. This destabilisation can create windows of opportunity for niche innovations to be selected into the dominant regime (Geels 2004; Holm *et al*., 2015).

Though conditions and activities at the regime and landscape levels are indeed influencing the transition process, this paper focuses only on the role of innovations. The paper investigates the innovations needed for supporting the sustainable transition of the building sector and outlines a number of areas in which practitioners and researcher should concentrate their innovation activities.

METHODOLOGY

Expert interviews is an efficient and concentrated method of gathering broad and widespread data, and is thus considered useful for exploring the sustainable building sector in Scandinavia. The notion of "expert" in research methodology refers to a person with a particular knowledge that the expert may not necessarily possess alone, but which is not accessible to anybody in the field of action under study. Experts usually have a privileged access to information about groups of persons or decision processes and have a high level of aggregated and specific knowledge that is otherwise difficult to access (Meuser and Nagel 2009).

The empirical exploration of the sustainable building sector in Scandinavia is based on twelve expert interviews. The experts are key persons from universities, non-governmental organisations, private companies, and governmental and administrative organisations in Denmark, Norway and Sweden. The criteria for selecting the experts are that they each hold relevant and supplemental knowledge of sustainable building, that they are positioned within areas of innovation and development, and that they in total are representative of the building sector in Scandinavia. The selected experts are presented in table 1.

The interviews were semi-structured based on open questions and a topic guide, as recommended by Meuser and Nagel (2009). The interviews took place in January-February 2016 and each interview lasted about one hour, and was recorded and transcribed. The extracts of the interview text were coded, thematised and further analysed. The majority of the interviews were conducted in the native language of the expert (i.e. Danish, Swedish or Norwegian) and a few in English. To include quotations in this paper, the author has translated parts of the transcribed interviews.

FINDINGS

According to the experts, sustainability is a substantial aspect of the Scandinavian building sector. However, the transition of the building sector is not complete; there is still a need for further development within a number of areas. This section outlines five directions, in which the Scandinavian building sector, according to the experts, is likely to move:

The focus will shift from energy to emissions
The concept of circular economy will be further introduced
The focus on the existing residential building stock will increase
The circumstances for collaboration will become more complex
The focus on social sustainability aspects will increase

Furthermore, the experts list a number of innovations needed for the building sector to move in the directions suggested.

From energy to emissions

The experts all emphasise that the environmental focus in the Scandinavian building sector is currently shifting from energy to emissions of greenhouse gasses: "We are approaching a break-even point where the regulations regarding energy use in buildings cannot become more demanding. The focus forward will be more on materials and CO2 emissions than on operation and consumption" (Norwegian architect). The experts predict that the forthcoming regulations will contain requirements for limited emissions related to building components and materials.

Table 1: Overview of background and knowledge areas of the experts interviewed

Type of company/organisation	Position of expert	Knowledge area
Norway		
Technical University Dep. of Architectural Design, History and Technology	Professor Architect	Research within sustainable architectural design and technology
Association for Clients, Contractors and Craftsmen	Director Engineer	Political agendas within the field of environment and energy in the Norwegian building sector
Architectural firm (350 employees)	Technology and Sustainability Manager Architect	Sustainable design in practice across Scandinavia
Consulting Engineering firm (850 employees)	Senior consultant Engineer	Sustainable building in practice, participation in several research projects
Denmark		
Association for Contractors	Director Architect, MPA	Political agendas of the Danish building sector. Administration of several inter-organisational development projects
Association for Construction Clients	Head of Projects Architect	Sustainability activities of Danish construction clients, author of several white papers on sustainable building
University Dep. of Development and Planning	Assistant Professor Engineer	Research in sustainable transition of socio-technical systems including the building sector
Architectural firm (75 employees)	Senior partner and director Architect	Innovation activities within sustainable design
Region administration Dep. of Climate and Resources	Chief consultant Facilities Management	Sustainable operation of buildings
R&D agency	Special consultant Engineer	R&D within ideation and launch of innovative sustainable building solutions
Sweden		
Technical University Div. of Building Technology	Professor Engineer	Research within life cycle assessment of construction materials and sustainability assessment tools for buildings
Technical University Centre for Management of the Built Environment	CEO	Research and industrial state-of-the-art within construction management

To support the shift of focus from energy to emissions, new technologies for documenting the properties of the building materials and components are needed. The development of Environmental Product Declarations (EPDs) is already in progress in all three Scandinavian countries, but also new applications in Building Information Modelling (BIM) are necessary to secure sufficient knowledge of the buildings: “We

need documentation of what is actually in the buildings when refurbishment is needed in 50-60 years" (Danish association representative).

The circular economy concept

In the past 5 years, certification systems such as LEED, BREEAM and DGNB have been used as "a very good way of operationalising sustainability" (Norwegian architect). Certification systems offer the practitioners a simple solution to the very complex task of designing measurable sustainable buildings. As the focus of the building sector shifts from energy to emissions, the attention on optimised use of resources, including a significant focus on waste, recycling and upcycling, increases. The circular economy concept, where costs of the products, their energy and resource consumption and their greenhouse gas emissions are assessed in a cradle-to-cradle perspective, connects these new aspects of sustainable building. Circular economy is a much-discussed topic, and the experts expect the concept to develop substantially in the next few years to become a leading paradigm for managing sustainable building: "We have not completely understood the concept of circular economy yet, but there is a potential to develop a much needed holistic view on economy and sustainability" (Danish association representative).

Documentation innovations are needed to support the movement towards a circular economy approach: "BIM can become the key to circular economy" (Danish architect). The movement requires not only new technologies for measuring, collecting and visualising information on embedded energy and emissions, but also new holistic models of calculation. These models should take into account the entire life cycle of a building and its components from raw material, through use to re- and upcycling. Furthermore, the circular economy approach requires new ways of designing, e.g. to secure the option of disassembling individual parts and components that need maintenance or replacements. This concept of designing for disassembling opens up a large field of potential innovations within both technology and design processes.

Existing residential building stock

Despite the shift of focus from energy to emissions and resources, the amount of energy consumed in buildings still has to be substantially reduced. In Denmark, the ambition is to reduce the energy consumption of buildings with 75% from 2006 to 2020 (Energistyrelsen 2014). Energy refurbishment of residential buildings is key in this process, as 51% of the energy consumption in buildings in Denmark originates from single-family houses (Wittche *et al*., 2014). The same circumstances are present in Sweden and Norway: "The existing residences are the greatest challenge" (Norwegian association representative).

The main challenge for upgrading the existing residential building stock is related to economic incitements: "There is no political will to regulate on private property. We need a carrot, an economic incitement" (Norwegian association representative). This challenge gives rise to a need of both "innovations that can lower the prices of products" (Swedish researcher), but also business model innovations that provide "one-stop-shopping" (Norwegian engineer) for the house owners. System providers will have great business opportunities for offering innovative total solutions for refurbishment targeted towards house owners. Furthermore, suppliers and manufacturers also have potential business development opportunities, as the challenge of upgrading the existing houses calls for innovative low-priced, sustainable products.

Complex circumstances for collaboration

The circumstances for collaboration and management of building projects will most likely change within few years, as more and more new actors enter the building sector: “The understanding of what the building sector comprises will change. Google might be part of the sector as data owner” (Swedish researcher). Furthermore, the increasing demand for a holistic view on economy and sustainability also requires new ways of collaborating to ensure that all sustainable components are interconnected and aligned.

New ways of collaboration are essential for supporting the sustainable transition of the building sector: "I believe that the technological development is coming along, but the traditional ways for collaboration and construction management are unsuitable" (Swedish CEO). With the increasing political focus on developing renewable energy in Scandinavia, great opportunities for the building sector arise. Several innovations are needed in the overlap between the building and the energy sector, e.g. technology for storage of renewable energy in buildings. Furthermore, the challenge of refurbishing residential buildings calls for new organisational constellations, where energy-related companies merge with building companies to provide holistic energy solutions to building owners. "We need a dialogue between the sectors that produce and consume energy. In the future, the energy companies can rent areas from the owners of buildings that produce energy" (Norwegian engineer).

Social sustainability aspects

The fifth direction, in which the experts suggest the building sector to move, is towards a much larger focus on social sustainability than today: “We shouldn’t just focus on the technical solutions, but also on the use, the functionality, the operation” (Swedish researcher). Aspects of social sustainability that relates to the use of the buildings, e.g. indoor climate, health and safety and the perceived functionality of the building, are very important for the sustainable transition of the building sector. Not only because the productivity of e.g. employees and students is significantly affected by the indoor climate of their office or school, but also because the actual energy and water consumption of a building often turns out to be considerable larger than what has been calculated by the designing consultants.

The increasing focus on the functionality of buildings produces several needs for innovations. These include both new technological systems, e.g. within indoor climate, integrated PV or customised user tech, and “new ways of combining the different technical solutions” (Norwegian engineer). Considerable amounts of energy and emissions can be saved, if the different systems in a building are much more integrated and adjusted to the actual use of the building. “The technical systems must be able to be turned on and off quickly and easy when needed. It will almost be revolutionary! Think about how much energy that will be saved, and we already have the technology for it” (Norwegian architect). Furthermore, innovative user-adjusted systems are needed for securing a stable and healthy indoor climate; an increasing focus that also give rise to innovations within healthy materials, ventilation, daylight etc.

DISCUSSION

In summary, the twelve expert interviews outline five directions of sustainability in which the Scandinavian building sector is likely to move, and a list of innovations needed for this movement. Though the experts represent three different countries and have different positions as practitioners, researchers or association representatives,

their tale of the future in sustainable building is remarkable clear and uniform. During the interviews, all experts touched on the five directions, and several of the innovations mentioned in this paper were repeated by experts across disciplines and countries. That the experts agree so strongly on the paths to sustainable building indicates that the future for sustainable building is in fact very visible, perhaps even obvious.

Furthermore, the experts state that in addition to being clear, the five directions are reachable. The innovations needed, whether related to product innovations (e.g. technologies for emission documentation or low-priced products for housing refurbishment) or process innovations (e.g. new models for collaboration or user-behaviour oriented design), are not radical innovations. As the Norwegian architect stated in the last quote: "we already have the technology for it". The innovations needed to support the sustainable transition are all described by the experts as incremental innovations that should be able to be developed and brought to the market within a few years. The experts acknowledge, though, that there are barriers for innovation, e.g. the project oriented organisation of the building sector that hinders long-sighted, strategic innovation activities: "We work very project oriented and base our work on what is relevant for the individual client… What interests me in terms of innovation lies within a time horizon of 1-3 years max" (Danish architect). Nevertheless, the experts assess the sustainable transition of the Scandinavian building sector as fairly within reach.

This clear outline of the transition process brings hope to the communities working within sustainable building, be it researchers or practitioners. The assessment of the experts indicates that 'yes, we can' make the necessary movement towards sustainable building. We are not there yet, but the path is clear and the tools we need to get to the finish line seem manageable to develop. However, a contrasting thought cannot help to spring to my mind: Is the outline of the experts ambitious enough? Is there a risk for the building sector not to reach the national and global goals for sustainable transition? Are we unconsciously aiming too low, and thus missing the target? The consequences for this mismatch will be fatal, due to the significant role buildings play in the global transition towards sustainability, as stated in the introduction of this paper. Furthermore, as Scandinavia is viewed as frontrunners in the field of sustainable building, a deluded apprehension of the road ahead could end up with the blind leading the blind.

This foreboding of the experts' outline of the future for sustainable building being too unambitious to meet the actual global needs might turn out to be in vain; perhaps the directions are as clear as the experts state. However, the consequences of the low ambitions are too significant to ignore. I therefor request further research within the field of sustainable transition of the building sector in Scandinavia. I particularly propose a focus of studies on the potential mismatch between the global sustainability goals and the building sector's own ambitions and plans for activities. On the one hand, if such studies reveal that the global goals can in fact be reached by focusing on the directions and innovations outlined in this paper, the next step would be for practitioners and researchers to concentrate their R&D activities on these specific areas, producing the needed innovations and thus accelerating the movement towards sustainable building. On the other hand, if the studies show that further action is needed to reach the global goals, a new R&D agenda for sustainable building must be investigated and developed to secure that the Scandinavian building sector will lead the way in the right direction.

CONCLUSIONS

The aim of this paper is to investigate the sustainable transition process of the Scandinavian building sector with a particular focus on the directions the sustainable building sector in Scandinavia is moving, and the innovation processes needed to support this movement. Based on twelve expert interviews, five directions, in which the building sector is likely to move, are identified: (1) The focus will shift from energy to emissions; (2) the concept of circular economy will be further introduced; (3) the focus on the existing residential building stock will increase; (4) the circumstances for collaboration will become more complex; and (5) the focus on social sustainability aspects will increase. Furthermore, the experts list a number of innovations needed for the building sector to move in each of the five directions.

The findings indicate a very clear and manageable path for the sustainable transition of the Scandinavian building sector. However, a potential risk arises; that the outline of the experts is not ambitious enough for the building sector to reach the global goals for sustainability. As frontrunners, the Scandinavian building sector is expected to lead the way, and the risk of going in the wrong direction has too large consequences to be ignored. This paper proposes further research within the field of sustainable innovation processes to assist future actions for both practitioners and researcher and thus secure and support the sustainable transitions of the Scandinavian building sector.

REFERENCES

Berry, S, Davidson, K and Saman, W (2013) The impact of niche green developments in transforming the building sector: The case study of Lochiel Park. *Energy Policy*, **62**, 646-655.

Bossink, B a G (2004) Managing drivers of innovation in construction networks. *Journal of Construction Engineering and Management*, **130**(3), 337-345.

Chalmers, P (2014) *Climate Change: Implications for Buildings*. Cambridge: Cambridge Institute for Sustainability Leadership.

Energistyrelsen (2014) Strategi for Energirenovering Af Bygninger. Copenhagen: Danish Agency of Energy.

Geels, F W (2004) From sectoral systems of innovation to socio-technical systems : Insights about dynamics and change from sociology and institutional theory. *Research Policy*, **33**(6-7), 897-920.

Geels, F W (2014) Regime resistance against low-carbon transitions: Introducing politics and power into the multi-level perspective theory. *Culture and Society*, **31**(5), 21-40.

Geels, F W and Schot, J (2010) The dynamics of transitions: A socio-technical perspective. *In*: J Grin, J Rotmans and J Schot (Eds.) *Transitions to Sustainable Development : New Directions in the Study of Long Term Transformative Change*. London: Routledge, 11-101.

Gibbs, D and O'Neill, K (2015) Building a green economy? Sustainability transitions in the UK building sector. *Geoforum*, **59**, 133-141.

J Holm, Søndergård, B and Stauning, I (2015) *Sustainable Transition of Housing and Construction*. Frydenlund Publishers.

Häkkinen, T and Belloni, K (2011) Barriers and drivers for sustainable building. *Building Research and Information*, **39**(3), 239-255.

International Energy Agency (2013) *Transition to Sustainable Buildings: Strategies and opportunities to 2050*. OECD/IEA.

Kemp, R, Schot, J and Hoogma, R (1998) Regime shifts to sustainability through processes of niche formation: The approach of strategic niche management. *Technology Analysis and Strategic Management*, **10**(2), 175-195.

Koch, C and Buser, M (2015) Sitting between two chairs: Introducing social sustainability in three large swedish contractor companies. *In*: A Raiden and E Aboagye-Nimo (Eds.) *Proceedings 31st Annual ARCOM Conference, 7-9 September 2015, Lincoln, UK*. Association of Researchers in Construction Management, 397-406.

Meuser, M and Nagel, U (2009) The expert interview and changes in knowledge production. *In*: A Bogner, B Littig and W Menz (Eds.) *Interviewing Experts*. London: Palgrave Macmillan, 17-42.

O'Neill, K J and Gibbs, D C (2014) Towards a sustainable economy? Socio-technical transitions in the green building sector. *Local Environment: The International Journal of Justice and Sustainability*, **19**(6), 572-590.

Quitzau, M B, Hoffmann, B and Elle, M (2012) Local niche planning and its strategic implications for implementation of energy-efficient technology. *Technological Forecasting and Social Change*, **79**(6), 1049-1058.

Risholt, B and Berker, T (2013) Success for energy efficient renovation of dwellings—Learning from private homeowners. *Energy Policy*, 61, 1022-1030.

Robinson, W, Chan, P and Lau, T, 2015 How do technological niches emerge? A Case analysis of servitization in construction. *In*: A Raiden and E Aboagye-Nimo (Eds.) *Proceedings 31st Annual ARCOM Conference, 7-9 September 2015, Lincoln, UK*. Association of Researchers in Construction Management, 1157-1166.

Rohracher, H (2001) Managing the technological transition to sustainable construction of buildings: A socio-technical perspective. *Technology Analysis and Strategic Management*, **13**(1), 137-150.

Schot, J and Geels, F W (2008) Strategic niche management and sustainable innovation journeys : Theory, findings, research agenda, and policy. *Technology Analysis and Strategic Management*, **20**(5), 537-554.

Shove, E (1998) Gaps, barriers and conceptual chasm: Theories of technology transfer and energy in buildings. *Energy Policy*, **26**(15), 1105-1112.

Strand, R, Freeman, R E and Hockerts, K (2014) Corporate social responsibility and sustainability in Scandinavia: An overview. *Journal of Business Ethics*, **127**(1),1-15.

Wittche, K B, Kragh, J and Aggerholm, S (2014) *Potentielle Varmebesparelse Ved Løbende Bygningsrenovering Frem Til 2050*. Statens Byggeforskningsinstitut: Aalborg Universitet.

World Green Building Council (2013) *World Green Building Trends: Business Benefits Driving New and Retrofit Market Opportunities In Over 60 Countries*. Bedford: McGraw-Hill Construction.

Yong, H A, Pearce, A R and Ku, K, (2011) Paradigm shift of green buildings in the construction industry. *International Journal of Sustainable Building Technology and Urban Development*, **2**(1), 52-62.

Zuo, J and Zhao, Z Y, (2014) Green building research-current status and future agenda: A review. *Renewable and Sustainable Energy Reviews*, 30, 271-281.

HOW CAN THE UNITED KINGDOM CONSTRUCTION INDUSTRY IMPLEMENT SUSTAINABLE PROCUREMENT STRATEGIES?

Darryl Iles[1] and Paul Ryall

Faculty of Computing, Engineering & Science, University of South Wales, Treforest, Pontypridd, CF37 1DL, Wales.

The aim of this study was to examine the implementation of sustainable procurement within the United Kingdom construction industry. The research identified not only a range of benefits from the implementation of sustainable procurement strategies but also barriers. The research extended a previous scoping study and employed a cross-sectional study utilising semi-structured interviews to test the initial findings generated by the literature review, involving interviews representing a cross section of the United Kingdom construction industry. Barriers to implementation include cost, inertia and lack of knowledge, amongst others. Whilst the findings from the research suggest that there are a number of barriers to implementation, companies should embrace sustainable procurement and embed strategies within the organisations to achieve maximum benefits and cost savings. Those engaging in sustainable procurement strategies identified the most benefits and did not see cost as a barrier. The impact of these cost savings should be communicated more widely in the United Kingdom construction industry to quell the myth that implementation of sustainable procurement is expensive. Further collaboration would increase participation from those within an often fragmented and adversarial United Kingdom construction industry with a lack of knowledge and resistance to change. The Government should continue to encourage the supply chain to act sustainably and continue to improve awareness of sustainable procurement strategies through the provision of additional information and development of guidance. Having said that, there is much in terms of policy and principles of sustainable procurement but the implementation of these is unclear and contributes to the fragmentation and adversarial nature of the United Kingdom construction industry.

Keywords: corporate strategy, procurement, supply chain, sustainability.

INTRODUCTION

Sustainable procurement is defined by the UK Government in The National Sustainable Procurement Action Plan 'Procuring the Future' as "a process whereby organisations meet their needs for goods, services, works and utilities in a way that achieves value for money on a whole life basis in terms of generating benefits not only to the organisation, but also to society and the economy whilst minimising damage to the environment" (DEFRA, 2005). It is widely considered that sustainable procurement is becoming more significant in a construction industry that is recovering from an economic downturn. CIOB (2010) identify that sustainability is now incorporated in construction projects of all size, type and value. Whilst the

[1] darryl.iles@southwales.ac.uk

Iles, D and Ryall, P (2016) How Can The United Kingdom Construction Industry Implement Sustainable Procurement Strategies?. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference,* 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1121-1130.

Government is using its purchasing power to encourage implementation within the United Kingdom construction industry supply chain (RIBA 2012).

The implementation of sustainable procurement is of value to the United Kingdom construction industry, not only to address requirements under ISO26000 and BS8903 but to satisfy supply chain policies. It is widely recognised that there are many barriers to implementation, this results in the questioning: why should the United Kingdom adopt the implementation of sustainable procurement.

LITERATURE REVIEW

Sustainable Procurement

Sustainable procurement is defined by the British Standards Institute (BSI, 2010) as "purchasing goods and items or services whose production, use and disposal minimize negative impacts and encourage positive outcomes for the environment, economy and society". Sustainable procurement delivers the main objective of sustainable development through the consideration of social issues, community benefits and Targeted Recruitment and Training (Welsh Housing Quarterly, 2012)

It is a method of delivering goods or services whilst considering broader issues such as the socio economic impact. The Department for Environment, Food and Rural Affairs (DEFRA) support the notion that sustainable procurement helps ensure value for money and lower operational costs whilst protecting the environment and bringing us wider societal benefits.

The Government, as a major construction client, has an important role in driving the sustainability agenda (CIPS 2015, OGC 2004, Levene 1995). Following the 2012 London Olympics, DEFRA issued a guidance document for those involved with procurement of construction projects. Lord de Mauley (DEFRA, 2013a) boasts how London 2012 showed how sustainable procurement could be done practically and efficiently, lessons learned should be captured and taken on board by others.

The Government and therefore those within the supply chain engaged in public sector contracts are in a strong position to influence the United Kingdom construction industry supply chain to act sustainably. Government spending is “approximately 16% of the UK’s GDP (DEFRA, 2013b), central government alone buys the equivalent of 9%”. The introduction of various forms of legislation, policies and procedures on a macro level is not intended to be a barrier but a method to encourage wider implementation in the United Kingdom construction industry (Figure 1)

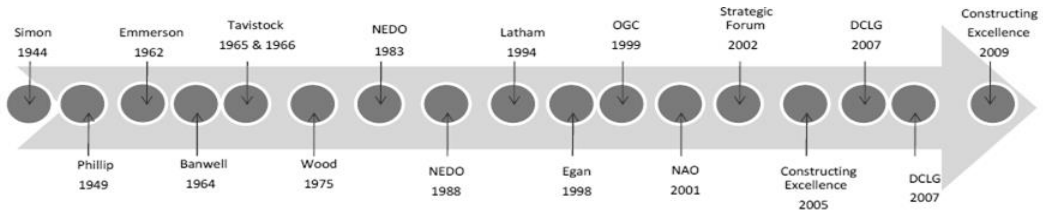


Figure 1: Key United Kingdom construction industry and Government reports

The International Standard for sustainable procurement ISO26000 and the British standard BS8903 are considered to be the globally recognised standards (Action Sustainability 2012, BSI 2010 and BSI 2015). They offer guidance for organisations to consider and implement sustainable practices within their procurement process. ISO26000 not only deals with the fundamentals of sustainable procurement but

explores the concept of complicity and the question of "Why procure sustainably?" which makes it more familiar to BS 8903 users. (McCarthy, 2015)

The United Kingdom construction industry

The United Kingdom construction industry represents a wide range of companies in various guises and sectors. Although there are a number of barriers to implementation within the literature, the homogeneity of the definition of United Kingdom construction industry is challenged and therefore the application of any conclusions or recommendations from the limited published data to the United Kingdom construction industry as a whole. The United Kingdom construction industry is diverse, fragmented and without definable boundaries and characteristic problems (Cox and Ireland, 2002, Berry and McCarthy, 2011, Groák 1994). Projects differ substantially from one another and significant discontinuities in flows of personnel, materials and information are created, such discontinuities are added to by the fragmentation of the project team and professional disciplines (Bresnen *et al.*,. 2003)

Collaborative working across these classifications is subsumed under the term partnering and is increasing in the United Kingdom construction industry. Partnering is not only a matter of learning new knowledge and adjusting existing working processes, it also requires discarding old routines and behaviour and overcoming vicious circles of reinforcing perceptions (Hartmann and Bresnen,2011). Collaborative working would suggest a common approach to sustainable procurement and its implementation within the supply chain, however, due to the fragmentation of the industry and the various barriers to implementation that exist (Constructing Excellence, 2008) this is often not the case.

Pearce (2003) recognises that when well designed, the built environment generates significant but, as yet, largely unquantified benefits in terms of human wellbeing - therefore recognising the importance of not only economic factors but the social value of construction and therefore the significance of sustainable procurement in the United Kingdom construction industry.

The implementation of Sustainable Procurement

Beyond the requirements of British or International standards, sustainable procurement offers many benefits for an organisation. These are summarised under 5 key business categories within BS8903 and include: Financial drivers, Risk, Organisational policy, Stakeholder expectations and awareness and Marketing. Barriers to implementation have been highlighted by Constructing Excellence (2008) and reaffirmed in more recent research (Hemmingsen, 2013).

Cost is perceived as a major barrier for the implementation of sustainable procurement by the majority. Unless cost savings can be achieved, products will not be adopted and sustainability would only be considered if it was a specific requirement from clients or planners (Constructing Excellence, 2008). However this is actively debated in the industry, some believe that sustainable procurement actually reduces the cost of construction (CIPS 2011, Dobson *et al.*, 2013).

This debate has contributed to increased media attention surrounding sustainable procurement, heightened by the introduction of ISO 20400 and the construction of large scale public contracts including the 2012 London Olympics. As a result, clients and contractors have committed to strive for sustainable projects with green credentials and have implemented sustainable procurement strategies in order to achieve this.

Table 1: Barriers to implementation

Barrier	Cited By respondents
Cost	93%
Lack of knowledge	53%
Availability of products	33%
Inertia/reluctance to change/tradition/fear of the unknown	33%
Conflict between legislation/planning and environmental protection	33%
Poor regulation/accreditation of products	33%

(Constructing Excellence, 2008)

Despite this commitment, a lack of knowledge is still considered as a barrier to implementation. Whilst there is a strong desire to make progress, many organisations don't have the tools or knowledge to move forward. This is attributed to reluctance to change, strong traditions and fear of the unknown and smaller enterprises needing stronger guidance and extra assistance in adopting sustainable procurement practices (Constructing Excellence, 2008). It is the smaller contractors and subcontractors in the United Kingdom construction industry who experience the most barriers to implementation (Morgan, 2013). The responsible sourcing of both labour and materials is seen as a great burden (Sedex 2015, McGoldrick 2013). A draft Global framework standard - BES 6001, has been issued by the BRE (2013) for the responsible sourcing of construction products to provide clarity on the subject. However, concern surrounding the way in which "local" is defined has been raised by McCarthy (2013).

Private-sector house builders and large organisations like the NHS require the use of locally-sourced supplies to reduce their carbon footprint. (Blighty, 2013) Shifting suppliers to one who is able to provide responsibly sourced materials affect those who rely on agreed fixed rates. Some may be forced to resort to uncertified products to meet deadlines or 'cut corners' (Constructing Excellence, 2008) Larger contractors such as Skanska (2011) are shifting the burden of procurement to their supply chain, expecting others to adapt their business practices and only doing business with those who are recognised as responsible suppliers and subcontractors. They require stringent levels of targeted recruitment and training, whilst sustainable labour sourcing through targeted recruitment and training schemes is commonly supported (RIBA 2012) it is a burden for many in the United Kingdom construction industry. Targeted recruitment and training represents an additional cost, not only in recruitment but training and development. Although a local, more educated workforce is beneficial, costs can be high and cash flow is restricted (McGoldrick 2013, Urquhart 2013).

RESEARCH APPROACH

The aim of this research was to further investigate the opportunities and barriers identified in the literature review in regards to the adoption of sustainable procurement in construction. The chosen methodological approach was a cross-sectional study. The research was concerned with understanding how sustainable procurement could be utilised in the future, including any barriers or limitations in its implementation and operation. The nature of cross-sectional studies is to collect primary data from a purposefully selected range of respondents.

The decision to utilise interviews was validated by the initial communications with potential respondents. Interviews offered a subjective and more accurate method of

data collection for a topic which is attitudinal based rather than numerical. The interaction within the interview process allows for the collection of detailed qualitative data that explores individuals' perspective and opinions. Table 2 illustrates the chosen interview sample.

Semi-structured interviews were preferred to enable the respondents to answer the questions in as much depth as possible. The interview questions were articulated from the provisional findings of the literature review and were collated in themes, the first questions allowed an informative data collection of individual and company details including experience of the topic. This was followed by more detailed questioning on the existence of any barriers or advantages when implementing sustainable procurement. The collection and analysis of data in the transcribed interviews allowed the establishment and confirmation of research themes which were then cross referenced, evaluated and results articulated. The coding of individual responses allowed for the collective evaluation of data within the key priori of advantages and disadvantages of implementation within the United Kingdom construction industry, addressing the findings of the literature.

Table 2: Profile of Interview Respondents

Respondent	Sample	Turnover	Number of Employees
A	Client	£5.8 billion	6,390
B	Contractor (General Construction)	£1.9 million	200
C	Contractor (Civil Engineer)	£4 billion	15,300
D	Manufacturer and Supplier (United Kingdom construction industry)	£334.1 million	2,132
E	Supplier (to UK House Builder)	£1million	120

RESULTS

Interviewees profile

All five interviewees had extensive experience working within the United Kingdom construction industry and had knowledge of commercial procurement strategies. At the time of the research, the interviewees were employees of different companies, within different sectors in the industry; contractor, client and supplier/manufacturer. Their roles ranged from site based engineers, cost consultants to head of sustainability and directors. This provided a variety of perspectives and a representative, albeit restrictive, cross section of the United Kingdom construction industry. Future research should include the synthesis of primary data from a larger sample of similarly experienced sources to provide more detailed and extensive primary data.

Implementation of Sustainable Procurement

40% of respondents did not have a formal policy that needed to be adhered to but outlined ways in which the company implements sustainable procurement strategies, demonstrating a knowledge of the topic.

Methods of sustainable procurement were identified by all, the most common being the responsible sourcing of goods and materials in order to improve corporate image. This was mainly implemented through the use of a local supply chain, purchasing sustainable materials and working within the community. 60% of the interviewees

demonstrated a commitment to additional methods including waste management plans, the monitoring and reduction of emissions and a dedicated intranet service to sustainability.

All interviewees referred to cost implications without prompt, this subconscious awareness of cost as a barrier to implementation was further probed, identifying a difference of opinion reflective of those of Constructing Excellence (2008) and CIPS (2011) and Dobson *et al.*, (2013). A stated that the implementation of sustainable procurement strategies was wholly dependent on the cost to the company, in comparison, D stated that their approach was to buy goods and services based on the best value and not cheapest price.

> We have a sustainable procurement policy which is about buying best value not cheapest price and understanding responsible sourcing throughout the supply chain.

A difference in attitude was identified according to the respondents' company and their role in the supply chain. A confirmed a difference in approach as their company switched roles between client and contractor, as a client they did not place any requirements on others, but when employed as a contractor they passed the requirements for sustainability through the supply chain. When questioned on the morality and necessity of this it became apparent that sustainability is perceived as a burden, sentiments articulated in Constructing Excellence (2008) and McGoldrick (2013). By contrast, 60% of interviewees felt that sustainability was and should be embedded into the corporate values of the company by choice and not necessity.

> Sustainability is about reducing your impact on the environment, it makes good business sense to reduce the impact on the environment and society and improve corporate responsibility and image.

The requirement to act sustainably is found to be driven mainly from public sector employers, whereas private sector clients, such as a UK house builder, did not demand any sustainability credentials. It was identified that the respondents representing the contractors and clients in the industry are often able to pass the requirements of sustainable procurement through the supply chain and alleviate the burden, perceived or otherwise, reflecting the experiences of Skanska (2011)

Benefits of implementation

Despite a perception of cost being a barrier to implementation, cost savings were cited as an advantage of implementation by 40% of interviewees. The use of a local supply chain resulted in more competitive prices, savings which were increased further through a reduction in programme. It is often the case that the actual cost of implementation is lower than the perceived cost and the cost is negligible in relation to turnover, between 0-3% (Morgan, 2013). It was the companies not engaged with implementation who perceived cost to be a major barrier, furthermore, these companies also cited the most barriers to implementation. The respondents representing companies that embed sustainable procurement policies throughout the business did not consider sustainability as a separate cost centre and provided evidence that the actual costs of implementation are minimal.

Most interviewees agreed that sustainable procurement improved the corporate image of a company and led to a competitive advantage when tendering, D also believed that sustainability was able to provide a good return for the business as it provided clear focus and corporate transparency.

> I've also known a reduction in programme time too as the lead time on locally sourced materials is less than those that would be shipped globally or nationally

Those who were not regulated to incorporate sustainable procurement held an awareness of the issue and identified a stakeholder expectation to incorporate and embed sustainability within the ethos of the company.

Barriers to implementation

A local supply chain may not always provide the best option as they may not have the financial capabilities or the necessary resources available to them. This was recognised to have a detrimental impact on corporate relationships and contribute to the adversarial and fragmented image of the United Kingdom construction industry (Cox and Ireland, 2002, Berry and McCarthy, 2011, Groák 1994).

Cost was perceived to be a disadvantage by 40% of respondents, however as discussed previously the validity of this view is questionable; the respondents citing cost as a barrier represented companies not engaging with sustainable procurement, reinforcing the view of Constructing Excellence (2008) who cited inertia or lack of knowledge as a barrier.

Attitudes towards approach

All respondents recognised a moral obligation to implement sustainable procurement. Some recognised that they do this as part of their corporate social responsibility targets and the positive impact on their reputation, or because it makes business sense.

DISCUSSION

A definition has been provided for sustainable procurement and a number of issues have been outlined in BS8903 that should be considered by an organisation. The Government as a major construction client have undertaken research to establish best practice and use their purchasing power to influence the supply chain. Having said this, the United Kingdom construction industry is often fragmented (Bresnen *et al.*, 2003) and those working within the industry are often reluctant to react to change. The definition of United Kingdom construction industry is homogeneous and any inferences from the data cannot necessary apply to the entire industry. Similarly, the interview sample is restrictive and primary data obtained only provides a small view into the large and varied industry.

Barriers to implementation exist and are a cause for concern for the industry. These include cost, inertia and a lack of knowledge. Evidence has been provided within the primary data that demonstrates there is an awareness of sustainable procurement within the United Kingdom construction industry and also a stakeholder expectation to incorporate sustainability within the ethos of the company.

Beyond meeting legislative requirements, sustainable procurement offers many benefits for an organisation, summarised within ISO20400 and BS8903 and supported by both the secondary data in the literature and by interview respondents. Sustainable procurement can lead to a derivation of a more positive image, not solely to contribute to any corporate social responsibility targets, but more so acting on a moral obligation.

Contractors such as Skanska (2011) are able to shift the burden of procurement to their supply chain and where the supply chain fails to meet any requirements imposed on them, there is a negative impact on working relationships. This can occur where the engagement of a local supply chain is not practical, if they do not have the financial capabilities or the appropriate resources available to them. Nevertheless, a

local supply chain offered some the opportunity to maximise cost savings due to more competitive pricing and reduction in programme duration.

It is apparent that there is a driving force to implement sustainability within the United Kingdom construction industry, largely from the public sector and driven by the Government (Bresnen. *et al.*, 2003). However some private sector clients, such as a UK house builder, do not express many, if any sustainable procurement requirements.

Regardless of pressure from within the supply chain to implement sustainable procurement strategies, there is evidence that the majority of organisations are embracing sustainability. Those who have implemented strategies believe that the benefits outweigh any barriers.

CONCLUSIONS

Although it has been demonstrated that there is much in terms of policy and procedure apparent through industry (Skanska, 2011) and guidance standards such as ISO20400 and BS8903, the standardisation of implementation throughout the industry is not apparent. There is a vast difference in attitudes and this is reflected in the adoption and implementation of sustainable procurement throughout the United Kingdom construction industry. The concept of complicity and the question of "Why procure sustainably?" exists for many (McCarthy, 2015) and is reflected by non-adoption of sustainable procurement within companies. This attributes to an undesirable perception that there are many barriers to implementation, the most significant being cost (Constructing Excellence, 2008) although when examined, actual costs incurred are insignificant (Morgan, 2013). It was surprising to find that the barriers cited by Constructing Excellence (2008) were mirrored in research by the authors but found to be supported exclusively by those who do not engage with sustainable procurement. Based on this sample, barriers were unfounded and spread a negativity within the industry. It is recognised that a collaborative and uninhibited drive to dispel inertia and improve a lack of knowledge may create a more cohesive and standardised approach to implementation.

REFERENCES

Action Sustainability (2012) *BS 8903: Principles and Framework for Procuring Sustainability*. Available from: http://www.actionsustainability.com/bs8903/ [13 December 12].

Berry, C and McCarthy, S (2011) *Guide to Sustainable Procurement in Construction*. Available from: http://www.ciria.org/service/Web_Site/AM/ContentManager Net/ContentDisplay.aspx?Section=Web_SiteandContentID=19278 [15 October 2012].

Blighty (2013) *The Great British Timber Shortage*. Available from: http://www. economist.com/blogs/blighty/2013/10/building-materials [18 November 2013]

Bresnen M, Edelman L, Newell S, Scarbrough H and Swan J (2003) Social practices and the management of knowledge in project environments. *International Journal of Project Management*, **21**(3), 157-166.

British Standards Institute (2010) *BS8903:2010 Principles And Framework For Procuring Sustainably*. London: British Standards Institute.

British Standards Institute (2015) *Comment On The New International Standard For Sustainable Procurement*. Available from: http://www.bsigroup.com/en-GB/about-bsi/media-centre/press-releases/2015/november/Comment-on-the-new-International-Standard-for-Sustainable-Procurement-/#.V1k7u00UVzk [02 June 2016]

Building Research Establishment (2013) *The Responsible Sourcing of Construction Products*. Available from: http://www.bre.co.uk/page.jsp? id=3104 [18 November 2013]

The Chartered Institute of Building (2010) *Procurement In The Construction Industry*. Berkshire: The Chartered Institute of Building

The Chartered Institute of Purchasing and Supply (2015) *Ethical and Sustainable Procurement*.

Constructing Excellence (2008) *Barriers to Sustainable Procurement in the Construction Industry*. Available from: http://www.constructingexcellence.org.uk/zones /sustainabilityzone/commissions/msc_report.pdf [18 November 2013].

Cox, A and Ireland, P (2002) Managing construction supply chains: The common sense approach. *Engineering, Construction and Architectural Management*, 9(**5/6**), 409–418.

Department for Environment, Food and Rural Affairs (2005) *Securing the Future: Delivering UK Sustainable Development Strategy*. London: Department for Environment, Food and Rural Affairs

Department for Environment, Food and Rural Affairs (2013a) *London 2012 Olympic and Paralympic Games The Legacy: Sustainable Procurement for Construction Projects*. London: Department for Environment, Food and Rural Affairs

Department for Environment, Food and Rural Affairs (2013b) *Making Sustainable Development A Part of All Government Policy And Operations*. London: Department for Environment, Food and Rural Affairs

Dobson D W, Sourani A, Sertyesilisik B and Tunstall, A (2013) Sustainable Construction: Analysis of Its Costs and Benefits. *American Journal of Civil Engineering and Architecture*, **1**(2), 32-38.

Groák, S., 1994 "Is construction an industry?" Construction Management and Economics, Vol. 12, No. 4, pp. 287 - 293.

Hartmann, A and Bresnen, M (2011) The emergence of partnering in construction practice: an activity theory perspective. *Engineering Project Organization Journal*. **1**(1), 41-52.

Hemmingsen, A S (2013) *7 Barriers To Implementing A Sustainable Approach In The Procurement Function*. Available from: 7-barriers-implementing-sustainable-approach-procurement-function [Accessed 09 June 2016]

Levene, P (1995) *Construction Procurement by Government: An Efficiency Unit Scrutiny (The Levene Report)*. London: Efficiency Unit Cabinet Office

McCarthy, S (2013) *Local Is Going Global*. Available from: http://www.building.co.uk/local-is-going-global/5062601.article [15 November 2013]

McCarthy, S (2015) *International Standard for Sustainable Procurement Forging Ahead*. Available from: http://www.cips.org/supply-management/opinion/2015/july /international-standard-for-sustainable-procurement-forging-ahead/ [15 May 2016]

McGoldrick, M., 2013. Oral Interview with the authors. Newport. 3 January 2013.

Morgan, D (2013) *An Examination Of The Implementation Of Sustainable Procurement By a Subcontractor in the Construction Industry*. Unpublished dissertation. University of South Wales

Office of Government Commerce (2004) *Procurement Guide 10*: London: Office of Government Commerce.

Pearce D (2003) *The Social and Economic Value of Construction*. nCRISP, Davis Langdon Consultancy: London. Available from: www.ccinw.com/images/publications/NCrisp%20The%20Social%20and%20Economic%20Value%20of%20Construction.pdf [5th April 2016]

Royal Institute of British Architects (2012) *Building Ladders of Opportunity: How Reforming Construction Procurement Can Drive Growth in the UK Economy*. London.

Sedex, (2015) *Case Study: How Sedex Is Helping Bacardi To Manage Its Responsible Sourcing Programme*. Available from: http://www.sedexglobal.com/case-study-how-sedex-is-helping-bacardi-to-manage-its-responsible-sourcing-programme/ [09 June 2016]

Skanska (2011). *Skanska Sustainable Procurement*. Available from: http://www.skanska.co.uk/Global/About%20Skanska/supply%20chain/Skanska%20Sustainable%20Procurement%20Policy%20May%202011.pdf [15 October 2012]

Urquhart, C, (2013) *Housing Boom Brings Year of the £40k Brickie*. Available from: http://www.theguardian.com/business/2013/sep/22/britain-runs-out-of-bricklayers [11 November 2013]

Welsh Housing Quarterly (2012) *The Can Do Toolkit: Targeted Recruitment and Training for Social Landlords*. Available from: http://www.whq.org.uk/docs/i2i/english/aboutDocE21.pdf [25 October 2012]

ORGANISING SUSTAINABLE TRANSITION: UNDERSTANDING THE PRODUCT, PROJECT AND SERVICE DOMAIN OF THE BUILT ENVIRONMENT

Christian Thuesen[1], Nina Koch-Ørvad and Esmir Maslesa

Management Engineering, Technical University of Denmark, Produktionstorvet, Building 424, 2800 Kongens Lyngby, Denmark

Sustainable transition of the built environment construction industry is challenging the existing construction practices and business models. This article presents a framework for understanding and facilitating sustainable transition in the built environment. The framework was developed through a four years innovation project based on theories on sectorial and business model innovation and ten detailed case studies of different types of companies and their experimentation with different management and sustainability concepts. The framework interprets the construction industry as a collection of three generic domains - the Project, Product and Service domain - with widely different markets, companies, business models and regulation. Besides identifying the characteristics of the different domains, the findings show that these domains are interdependent, but largely live their own lives with internal agendas. Furthermore, it is shown that the domains are subject to more or less consciously coordinated innovation activities. The research concludes that the three-domain-model represents a promising framework for understanding and facilitating sustainable transition of the construction industry and built environment.

Keywords: sustainability, sectorial innovation, business models

INTRODUCTION

Construction has always been important in the shaping of society by creating the context in which human activities can flourish. Until recently the actors within construction have not considered the broader impact of their practices shaping not only society but also the world in which we are living especially when it comes to sustainable development.

It is widely acknowledged that the construction industry is crucial in the ambition of creating a sustainable society (International Energy Agency 2013). 40% of the CO2 emissions come from the buildings. Thus, there is great potential and need for a sustainable transition of construction products and practices. In Denmark the movement towards sustainable construction is now formulated as the general policy for the industry (Klima- Energi- og bygningsministeriet 2014) that specifically formulates targets for 2020 and 2050.

The starting point for this development has been an interaction between interest groups and the government focused on creating a regulatory frame for construction that is not only ambitious, but also realistic in relation to the skills and resources of the

[1] chth@dtu.dk

Thuesen, C, Koch-Ørvad, N and Maslesa, E (2016) Organising Sustainable Transition: Understanding the Product, Project and Service Domain of the Built Environment. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1131-1140.

industry actors. Even though this perspective is important, it has not focused on companies' impact on innovation in construction. This lack of focus on corporate impact leads us to the purpose of this research.

Ambition

The aim of the paper is to lay the foundation for sustainable transition of construction by creating an understanding of how companies adopt sustainable construction practices within a wider innovation system.

Theorizing sustainable transition

Numerous researchers have taken up the challenge on theorising sustainable transition and several theories have been developed. One of these - the Multi-Level Perspective (MLP) (Schot and Geels 2008; Geels 2004) - look upon sectorial transition as a socio-technical phenomenon and identify three levels of socio-technical interaction (illustrated in figure 1) within which transition can be explained. This theoretical framing of sustainable transition is supported generally (Grin *et al*., 2010) and specifically for the built environment (Thuesen and Koch 2011; D. Gibbs and O'Neill 2014; D. Gibbs and O'Neill 2015)

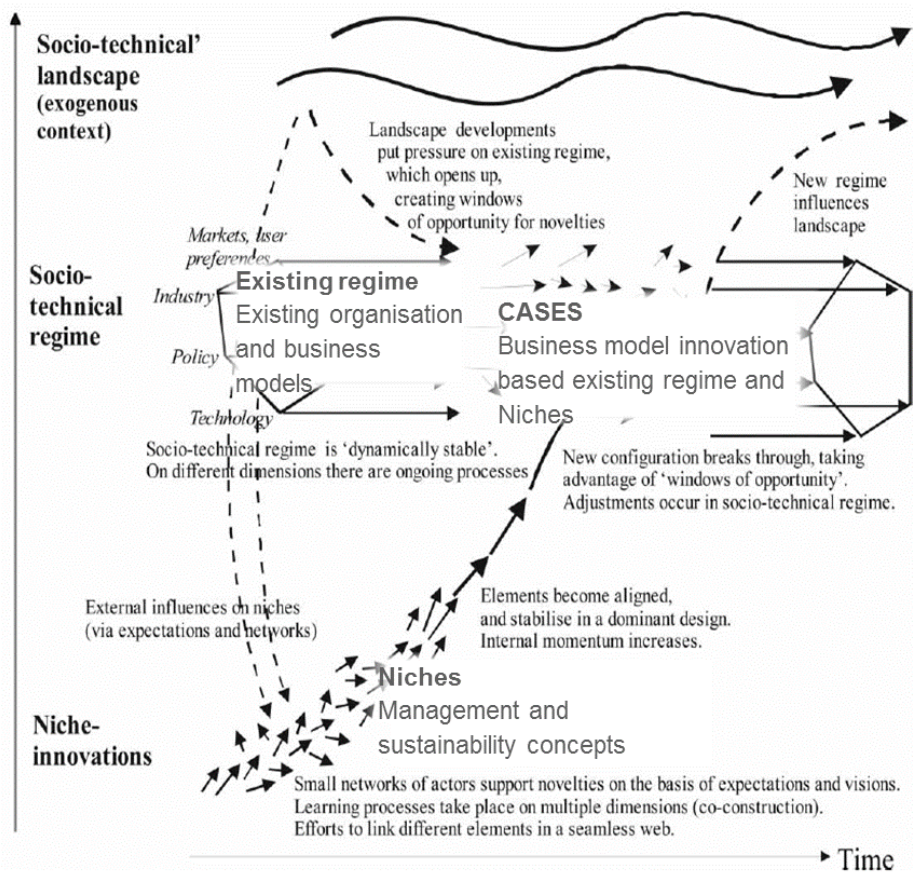


Figure 1: Framing Sustainable Transitions using the Multi-Level Perspective

The macro-level is formed by the socio-technical landscape, an exogenous environment beyond the direct influence of actors in the other levels (e.g. macro-economics, deep cultural patterns, macro-political developments). Here Gibbs and O'Neill (2014) suggest that the current environmental concerns and the policy shift to a green economy represent tensions, and thus creates a window of opportunity for exploration of new trajectories for green construction.

The socio-technical regime forms the meso-level, representing the dominating stabilised socio-technical pattern of interaction, which is reproduced by institutionalised learning processes. A socio-technical regime can for instance be the building and construction industry (Thuesen and Koch 2011; Gibbs and O'Neill 2015), and is defined by a common set of (unwritten) rules for practices and processes, ways of handling specific things and persons, ways of defining problems etc.

Niches form the micro-level where radical novelties emerge. According to Geels and Kemp (2007), several researchers within sociology of technology and evolutionary economics have stressed the importance of niches as innovation drivers, from where new socio-technical regimes can be developed (Levinthal 1998; Schot 1998). Niches work as incubation environments for new ideas by being protected from the traditional selection mechanisms of the marketplace. According to Schot and Geels (2008) sustainable transition can be facilitated by creating technological niches, i.e. protected spaces that allow the experimentation with the co-evolution of technology, user practices, and regulatory structures. By distinguishing between market and technological niches, Schot and Geels (2008) explain how innovation can be achieved through institutional learning processes linking technological niches to niche markets. To understand these learning mechanisms that usually takes place within and among companies, the project adapts the principles of business models innovation (Osterwalder and Pigneur 2013).

METHODOLOGY

The project is based on a series of case studies that introduce various examples of sustainable business model innovation (Maslesa *et al*., 2014) (an overview is presented in table 1). The method used is a multi-case-study (Yin 2012) with a focus on creating a holistic understanding of sustainable transition practices.

Table 1: Case overview

Case	Type	Domain	Management Concepts	Sustainability Concepts
1. Danish Energy Management DEM	Technical consultant	Project / service		ESCO
2. Domea	Building owner	Project / service	BIM, SysDel,	BR15*, Passive house
3. UNS4	Partnership	Project / product	BIM, SysDel	BR15*, Passive house
4. EnergyLean			Lean	
5. SE Big Blue	Energy provider	Service / project	Lean	Industrial Symbiosis
6. Adsbøll & sons	Contractor	Project	Partnership,	BR15*
7. Nilan	Producer	Product	Lean, SysDel,	BR15* Passive house
8. Årstiderne Arkitekter	Architect	Project	Partnership, SysDel,	BR15* Passive house
9. BM Byggeindustri	Contractor	Product / project	Partnership, SysDel,	BR15* Passive house
10. WorldFlex-home	Partnership	Product / project	Partnership, SysDel,	BR20* Active house

**) BR15/20: Danish Building Code of 2015 / 2020*

The case studies are based on semi-structured interviews (Kvale 2007) with central actors in selected companies, site visits, project reports, and meeting notes from specific projects. The focus of the empirical collection has been on how niches (in the form of management and sustainable concepts) creates changes in the way companies do business.

Specifically the research investigated three interlinked levels to conceptualise the transition processes: (1) The innovation project/initiative in which a concept/niche is tested and experiences are created. (2) The business level focusing on how the innovation is embedded, challenge and reshape the existing business model of the company. (3) The innovation system setting the context for the company's innovation activities through the sectorial organisation and different niches (concepts).

The selected cases are primarily from Denmark, with a specific focus on small and medium sized enterprises (SMEs) since these represent the majority of the companies in the industry and further are believed to be of outmost importance in the transition processes of the industry. The cases covered different types of companies: from manufacturers to service providers that all worked more or less intentionally with different types of niches covering both management and sustainability concepts.

Throughout the project, it became clear that the concept of sustainability is challenging to work with in practice, e.g. how to assess the sustainable impact of the company's choice. The aim of the project was not to develop specific models and methods for assessing which innovation type was more sustainable. This important field is widely covered by Life Cycle Assessment (LCA) research. Thus, this paper focuses on understanding how companies work with sustainable niches/concepts in their usual innovation activities. In line with (Geels 2010) we view sustainable construction as a normative goal and a collective good problem that establishes a vision serving as an orientation point for the development of the companies. The interesting part is not the final destination itself, but the way to arrive there.

ANALYSIS

The analysis is structured in two sections. The first section introduces a conceptualisation of the existing regime illustrated by three domains for understanding the constructions industry. The second section outlines different niches/concepts and how they are integrated in the cases and domains.

The existing regime: The construction industry organised in three domains

Overall, the construction industry can be conceptualised as a collection of three generic domains with widely different markets, companies, business models and regulations. The three domains the Project, Product, and Service domain illustrated in figure 2 are all central in the realisation and operation of the built environment.

The project domain

The project-oriented domain is the most prevalent and visible domain in construction today, as this is where buildings are realised. In the Project domain, traditional construction actors such as architects (case 1 and 8), consultants (case 4 and 1), contractors (case 2, 6, 9 and10) and various crafts (case 6 and 9) plan, design and construct buildings to the individual clients. The production form is project based. The building is realise by a unique team, on a unique location, and over a fixed timeframe.

The foundation of the business models in the project domain is based on selling hours. The hours are usually included in the tendering and competition models in which a customer can choose from a wide range of offers from companies to complete a task and to ensure cost control of the projects. The costs of the project are usually based on a cost+ model, where costs are determined from design and an overhead. Furthermore, the cost structure of these companies is based on low fixed-costs, and high variable-costs. These companies have usually no physical assets in the form of production facilities and machinery, but have a clear predominance of variable costs (primarily salaries).

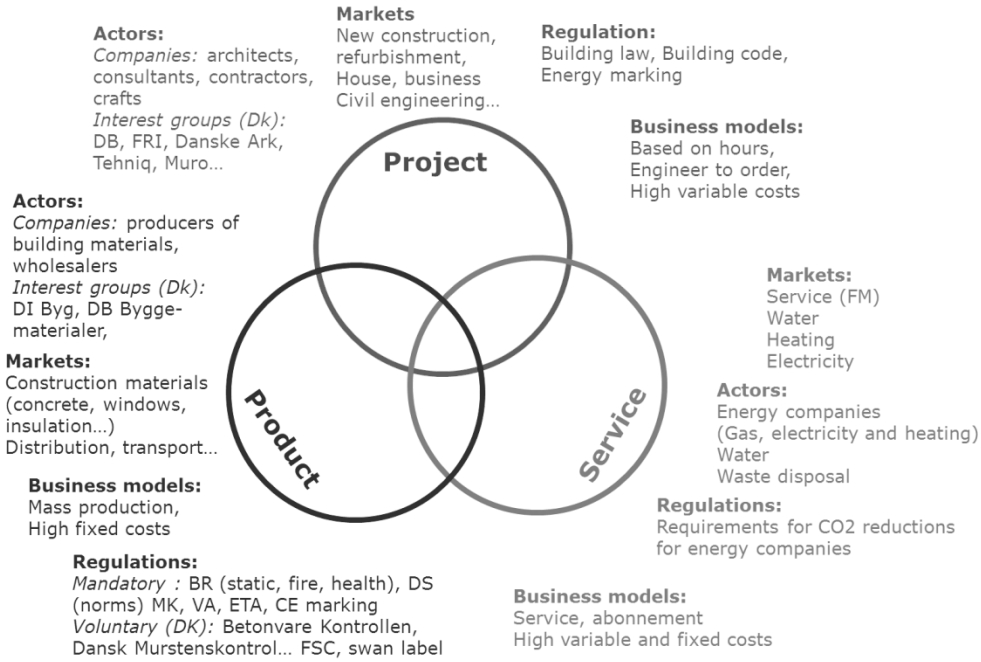


Figure 2: The three domains of the construction industry

The regulations of the Project domain focus on products and processes of the projects. In Denmark, concepts such as AB92, ABR, Working Environment Act etc. regulate the process while the built product is regulated by the building code (BR). This regulation ensures that the specific building meets common standards for energy consumption, fire protection and accessibility regulations. At the same time, the temporal dimension of the domain is underpinned by short liability periods (e.g. 5-10 years) compared with the building's overall lifespan. This ensures that companies are not constrained by the old projects, but may pertain to new.

The product domain

The product-oriented domain represents all the materials and products that go into the building – represented by the construction material industry. Historically, the construction material industry has been limited to simple types of materials such as wood, concrete, and bricks. However, over the last century the industry has witnessed an explosion of new building products. Since the range of building products and their variance increases, it is a challenge to navigate among the many options. The vast majority of the building products are produced through mass production, produced to stocks where the project-oriented companies subsequently can request their materials (case 9). This also means that there are considerable amount of wholesalers, connecting producers and building projects. These wholesalers have not been a part of the current research, though.

The regulations of the construction materials industry focus on the application of the product and the process for installing the product at the site. At the same time, the regulations ensure competition between products and enable continuous innovation in the industry. With the rise of the "internal market" of the European Union, the Product domain is heavily regulated by the EU, but also national regulations apply. Therefore, a wide range of rules, norms and standards exist, like the mandatory CE marking and fire protection standards, as well as the voluntary standards like Concrete Control and the Swan label.

The business models in the Product domain are primarily based on mass production in manufacturing environments with high fixed-costs. The vast majority of construction materials are produced for stock and delivered to the construction site through wholesalers, representing a store for the most common building products such as wood, tile, plumbing and electrical components. Compared to the Project domain, the business models are based on a strong separation of value and costs, and the price of the products is a result of what the market is willing to pay, not what it costs to produce the products.

The service domain

The service-oriented domain includes organisations and companies that provide services to the buildings at different operational levels. It may be cleaning, maintenance and other Facilities Management services, but also include service-providers of energy (case 5), water, sewage and waste disposal.

These organisations are usually not considered as a part of the construction industry, but this is changing. After entering office, the previous government in Denmark created a joint ministry for Climate, Energy and Buildings. Thus, the construction was introduced as part of the energy system with the purpose of realising the government's overall climate goals. This regulatory change introduced a number of new players to the Danish construction industry: energy and utilities companies.

The regulation of the Service domain has traditionally not attracted much focus within the Danish construction industry, but with the introduction of the construction sector in the energy system, new niches are created. One of the Danish regulatory initiatives is the requirement for energy companies to reduce their own CO2 emissions. To fulfil this requirement, energy companies have now an obvious interest in advising their customers how energy consumption in their buildings can be reduced. Therefore, the intersection between the Project and Service domain is changing.

The business models for businesses in the Service domain are selling services often in the form of subscriptions on energy supply (case 5), water, sewage and waste disposal.

Shared among all the three domains is a desire to satisfy specific needs in the markets in and around the built product. These markets are not the same, but they are connected. For example, there is an obvious link between the market of new buildings and construction materials. Similarly, there is a link between the Project and Service domain, since each construction project must have a technical infrastructure in form of electricity, heating, pluming and water. Although the markets are not the same, they ultimately relate to the same users. Over the three domains is thus a user perspective, which is important for the actual products, projects and services provided. The end-users are the ones who create demand and thus promote or impede innovation.

Niches/concepts

This section introduces a selected number of niches that challenge the existing organisation and practices of the industry. The niches represent both agendas that have an explicit sustainability focus (sustainability concepts) and more general management concepts. The management concepts include Partnerships, Lean, BIM and System deliveries (SysDel) while the sustainability concepts include the future Danish building code BR15/BR20, the Passive house and Active house concepts, ESCO models and Industrial Symbiosis (Bisgaard *et al*., 2012). Figure 3 illustrates how the different concepts is situated in the different domains.

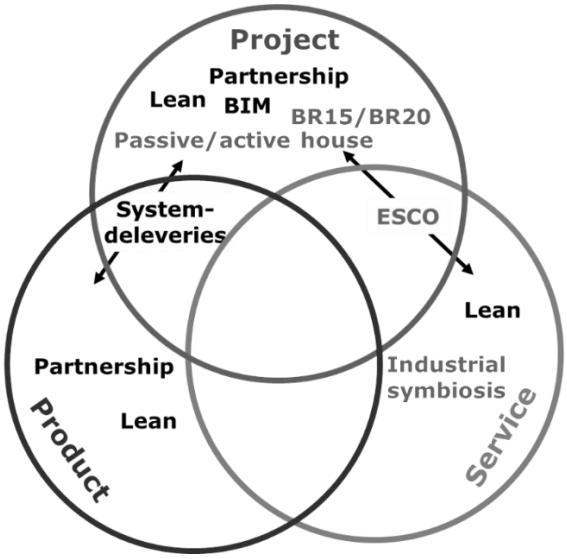


Figure 3: Managerial and sustainable concepts' connection in the three domains.

Through all the cases, it was found that these niches/concepts reshape the existing construction practices and business models. Thus, the model of the three domains is not to be understood as static. It is constantly changing and therefore dynamic. This change is not only happening within the each of the domains, but also in the interfaces between them. A number of niches have an impact on the future organisation of construction. Some examples here are the continuous development of the system deliveries (SysDel) and the interest of energy companies in energy savings. In other words, the boundaries between the domains represent new business opportunities followed by potentially new business models.

System deliveries (Case 2, 3, 7, 8, 9 and 10) are placed in the intersection between the Project and the Product domain. System deliveries are system products, products that are produced and adapted specially for the individual customer. These products may be concrete elements, facades, escalators etc. As these products are adapted to each customer, the purchase of these products does not include only production, but also a design process in which customer needs are translated into specific solutions. Some of these design processes are supported by configuration systems to ensure that the designed solutions comply with the requirements for the product, and at the same time are optimised for production and logistics.

The ESCO or Energy Service Companies (case 1) concept positions itself between the Project-oriented and Service-oriented domain. ESCO focuses on developing practical solutions for energy savings and is financed by the ESCO-supplier who in the end receives the financial benefit of energy savings. This model means that the supplier and the customer are tied together over a number of years, depending on the specific

ESCO-project. This long-term relation requires cooperation, because the behaviours of the building users directly affect energy savings.

DISCUSSION: SUSTAINABLE CONSTRUCTION?

The three domain model creates a holistic view of construction and offers a nuanced basis for understanding the sustainable transition of companies in the various domains.

The window of opportunity for the transition of sustainable construction will have a direct impact on niches and concepts within the individual domains. The central question is how to ensure that each individual domain contributes to this transition? The following table formulates the challenges associated with each of the domains and indicates relevant niches/concepts, which in different ways deal with the challenge.

Table 2: Domain challenges and solutions for sustainable transition

Domain	Challenge	Sustainability concepts
Product	Design and production of quality products with a long life and high energy efficiency and minimal consumption or maximum recycling of resources	LCA, C2C, CE marking, DFD (Design for Disassembly), SCS (Supply Chain Sustainability), TBM (Take Back Management)
Project	Design and construction of buildings with high architectural value that are energy efficient, environmentally friendly, well-insulated and has a good indoor climate.	DGNB, BREEAM, LEED, DFD (Design for Disassembly), sustainable construction site
Service	Operation and maintenance of buildings, ensuring a good indoor climate while energy costs are reduced.	SFM (Sustainable Facilities Management), ESCO, Green leases

Through the cases, we have investigated how construction companies orientate their development in the sustainable transition highlighting the role of business model innovation. The models and tools associated with the business models do not include a special focus on sustainability. However, by achieving a larger focus from the authorities and society, sustainability is increasingly incorporated into business practises.

According to Bisgaard *et al*., (2012), companies can be sustainable (green) by producing green products and services to other companies or customers, or they can become more sustainable by making the processes responsible for the interactions in the value chain more green. However, it can be difficult to assess these movements since an optimisation of a product / service or process can have negative trade-offs in other contexts.

At the same time, it is important not only to look at products / services and the underlying processes, but also to see whether companies help solve a sustainability challenge. It is not enough just to produce a "sustainable" new building when the main challenge of creating a sustainable built environment is associated with reducing energy consumption in the existing building stock.

Common to most of the cases are that the projects fail to manifest themselves in the business over a longer period. This was e.g. the case for the partnership UNS4 (case 4) and Adsbøll (case 6) that discontinued their strategies. These findings supports (Schot and Geels 2008) that sustainable transition is a matter of experimentation. Not all initiatives will survive, but some might influence future activities. In the abovementioned cases the barriers for pursuing sustainable innovation was associated

with market fluctuation and price sensitivity for the clients. However, it also illustrates a willingness to experiment among the actors of the industry.

The construction industry is often accused for being conservative and non-innovating. However, the selected cases clearly illustrate a wide range of innovation activities at all levels of the industry: from the large players (case 5 and 2), over SMEs (case 1, 8 and 9) to one-man initiatives (case 3 and10); and in all types of companies: architects (case 4, 8 and 10), consultants (case 1 and 4), producers (case 3, 7, 9 and 10), and service providers (case 2 and 5).

Furthermore, the cases studied show how regulation is a major driver of the sustainable innovation activities in the companies. This is particular the case regarding the transparency of the future Danish building code (BR15/20) which enables the companies to orientate themselves towards future building requirements (case 2, 3, 6,7,8, 9 and 10). Furthermore, the entrance of energy companies illustrates also how regulations create incentives for changes in the industry structure (case 5). Today, the construction industry in Denmark is not viewed and regulated as a separate entity, but considered as a part of the bigger picture of societal development.

DIRECTIONS FOR FURTHER RESEARCH

The introduction of the three-domain-model give rise to further research questions like:

- How are other management concepts and sustainable concepts contributing to the sustainable transition? This could include concepts like Eco-labelling and certification schemes (e.g. DGNB, LEED, BREEAM) and Circular economy models like C2C
- What is the role of different type of companies in sustainable transition of the built environment? Especially the role of the wholesalers connecting producers and building projects would be worthwhile investigating.
- What happens in detail at the company level? How are sustainable concepts selected, adapted and implemented to the specific company profile?
- How can companies be supported in the process of sustainable transition? Do we need to rethink the current tools and practices to support the specific domain?
- What is the role of regulation and policy making?

CONCLUSION

This article has introduced a new framework for understanding and facilitating sustainable transition in the built environment. The framework interprets the construction industry as a collection of three generic domains the Project, Product and Service domain - with widely different markets, companies, business models and regulations. All domains are central in the realisation and operation of the built environment.

The challenge is that these three domains are interdependent, but largely live their own lives with internal development agendas and concepts. The domains are not static, but exposed to a more or less consciously and coordinated influence of the companies with different strategies. Thereby the three domain framework creates a holistic view of construction that offers a more nuanced basis for understanding the sustainable transition of the construction industry.

REFERENCES

Bisgaard, T, Henriksen, K and Bjerre, M (2012) *Green Business Model Innovation Conceptualisation: Next Practice and Policy*. Nordic Innovation Report.

Geels, F W (2004) From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory. *Research Policy*, **33**(6-7), 897-920.

Geels, F W (2010) Ontologies, socio-technical transitions (to sustainability), and the multi-level perspective. *Research Policy*, **39**(4), 495-510.

Geels, F W and Kemp, R (2007) Dynamics in socio-technical systems: Typology of change processes and contrasting case studies. *Technology in Society*, **29**(4), 441-455.

Gibbs, D and O'Neill, K (2015) Building a green economy? Sustainability transitions in the UK building sector. Geoforum, **59**, 133-141.

Gibbs, D and O'Neill, K (2014) Rethinking sociotechnical transitions and green entrepreneurship: The potential for transformative change in the green building sector. *Environment and Planning*, **46**(5), 1088-1107.

Grin, J, Rotmans, J and Schot, J (2010) *Transitions to Sustainable Development : New Directions in the Study of Long Term Transformative Change*. London: Routledge.

International Energy Agency (2013) *Redrawing the Energy-Climate Map (World Energy Outlook Special Report)*. Paris: International Energy Agency.

Klima- Energi- og bygningsministeriet (2014) *Vejen til et styrket byggeri i Danmark*, (November), **95**.

Kvale, S (2007) *Doing Interviews*. London: Sage Publications.

Levinthal, D A (1998) The slow pace of rapid technological change: Gradualism and punctuation in technological change. *Industrial and Corporate Change*, **7**(2), 217-247.

Maslesa, E, Thomsen, A, Thuesen, C and Arnklit, S R (2014) *Innobyg Case-Samling Fra Udviklingsprojektet Bæredygtige Forretningsmodeller*. Copenhagen.

Osterwalder, A and Pigneur, Y (2013) *Business Model Generation: A Handbook For Visionaries, Game Changers, And Challengers*. Hoboken, NJ: John Wiley and Sons.

Schot, J, 1998 The usefulness of evolutionary models for explaining innovation: The case of the Netherlands in the nineteenth century. *History and Technology, An International Journal*, **14**(3), 173-200

Schot, J and Geels, F W (2008) Strategic niche management and sustainable innovation journeys: Theory, findings, research agenda, and policy. *Technology Analysis and Strategic Management*, **20**(5), 537-554.

Thuesen, C and Koch, C (2011) Driving sustainable innovation in construction companies. *In*: *Proceedings of Management and Innovation for a Sustainable Built Environment (MISBE 2011)*, 20 June - 23 June, Amsterdam, Netherlands, CIB.

Yin, R K (2012) *Applications of Case Study Research 3rd Edition*. Washington DC: Sage Publications, Inc.

THE ORGANIZATIONAL NEXUS OF CHANGING MANAGEMENT PRACTICES FOR SUSTAINABLE RENOVATION

Pernilla Gluch[1] and Ingrid Svensson

Division of Service Management and Logistics, Department of Technology Management and Economics, Chalmers University of Technology, SE-412 96 Gothenburg, Sweden

Ambitiously set governmental sustainability targets together with a run-down building stock in need of renovation force public construction client organisations to find sustainable and new ways to renovate. Besides technology development, these challenges require that sustainability targets are embedded in decision making practices. Focusing on organising processes and management practices related to sustainable renovation of public buildings in Sweden this paper outlines a future research proposal that acknowledges the intertwined relationship between multi-levelled processes in sustainable renovation, i.e. unveiling the organisational nexus of renovation management practice. Findings from an ongoing case study were analysed by applying an analytical lens inspired by the theoretical framework of institutional work. Focusing on organization processes and management practices the case concerns a 'strategy development process' for renovation of public pre-schools in Gothenburg, Sweden. In total six meeting observations and eleven interviews were conducted. A conceptual model describing the organizational nexus of changing management practice for sustainable renovation is presented, from which a set of critical research questions for further investigation is derived.

Keywords: construction client organisations, institutional work, management practice, multi-level analysis, public buildings, sustainable renovation

INTRODUCTION

In Sweden, many buildings were built between the years 1950-1975, including public buildings such as hospitals, schools and preschools. Now both the buildings and the technical systems are reaching their technical life span, thus need to be renovated or even demolished and replaced. The building sector in Sweden (like the EU) is, compared to 1995 levels, aiming at a 20% reduction in energy use by 2020 (Thollander *et al*., 2011). Since the public sector is stated to have a role-model position in energy reduction, the large building stock in need of renovation together with ambitiously set sustainability goals, will demand for public organisations to find new and sustainable ways to renovate and manage their building stock. However, a vast amount of studies show evidence of institutional, organizational, as well as psychological/individual barriers to sustainable construction that slow down and obstruct the mainstreaming of sustainable construction (Andrews and Johnson 2015; Henn and Hoffman 2013; vanBueren *et al*., 2013). In addition, public organizations

[1] pernilla.gluch@chalmers.se

Gluch, P and Svensson, I (2016) The Organizational Nexus of Changing Management Practices for Sustainable Renovation. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1141-1150.

face bureaucratic structures including risk aversion and conflicting fiscal responsibility (for an overview see Meyer *et al*., 2013).

According to Hoffmann and Henn (2008) research on environmental sustainability in businesses, including construction, requires consideration of three levels of analysis, individuals in organizational context, the behavioural and social characteristics of organizations themselves and the institutional structures, rules, norms and networks that influence their activity. Individual- or behavioural barriers include personal values and beliefs toward environmental issues as well as the tendency to rely on so called cognitive heuristics. Organizational barriers to green construction include communication failures and power shifts associated with evolvement of new roles initiated by new "green" technology and vocabularies (Hoffmann and Henn 2008). Institutional barriers include rules, norms, beliefs and logics embedded in the organizations larger institutional context (Andrews and Johnson 2015) as well as governmental regulations, policies and programs (Palm and Thollander 2010).

Research on organizations and social structures is found to be an understudied dimension for understanding and examining human dimensions in the field of green and sustainable buildings (Henn and Hoffman 2013). However, in a review of research on energy behaviour in business and organizations Andrews and Johnson (2015) found that organizational behaviour research has just recently begun to address energy efficiency and sustainability issues in building construction. Nevertheless, organisational behaviour research that investigates the intertwined relationship between the micro (individual) level, the organizational level and the macro (institutional) level is still underdeveloped. In addition, according to Janda and Topouzi (2015) there is a need for an increase of research where sustainability protagonists are seen as 'normal' employees who need to respond to changes in sustainable building policies. In line with these claims this paper develops a research proposal that acknowledge the intertwined relationship between micro and macro processes in (ecological) sustainable renovation, i.e. unveiling the nexus of sustainable renovation.

In order to investigate the intertwined relationship above mentioned we apply an analytical lens inspired by the theoretical framework of institutional work (Lawrence *et al*., 2011), hence taking interest in the "day-to-day" change work done by the "ordinary" employees as these relate to institutional change processes. Building on Crittenden's (2014) three level change framework a conceptual model describing the organizational nexus of changing management practices for renovation of public buildings is developed, from which a set of critical research questions for further investigation are outlined. Studies, taking into account other levels of analysis than the organization field level have been less common within institutional theory research. Thus, adopting a multi-level model of analysis answers the call for research contributing to a better understanding of intra-organizational change processes (Greenwood *et al*., 2013). This paper further contributes to an increased understanding of the specific case of renovation processes of public buildings, moving toward a resolution of the (expected) barriers to sustainable renovation in public organizations.

THEORETICIAL FRAMEWORK

Sustainable renovation research

A key for increased energy efficiency of public buildings forwarded by for example Person and Bratt (2010) is increased collaboration with stakeholders and informative measures within organizations regarding benefits from new sustainable technologies. However, in a study of a Swedish public housing company's energy efficient renovation process, Palm and Reindl (2016) found, by applying a practice theory framework, focusing on routines, technology, meanings, and knowledge, that for example project meetings as information channel did not provide opportunities for creativity and innovation. Instead, existing technical infrastructure largely determined what issues came up for discussion and most meetings were spent discussing technical details of 'old' technology. It was also found that theoretical knowledge tended to be overlooked at the advantage of practical "know-how". Moreover, other studies have shown that new constructions often are normative in determining construction practices (Mjörnell *et al*., 2014) which not always cohere with a (sustainable) renovation process where different, and sometimes conflicting, knowledge areas, values and objectives needs to be accounted for (Thuvander *et al*., 2012). Insufficient organizational structures (and culture), short term political decision-making horizons and lack of standardized routines focusing on sustainable and energy efficient renovation processes are other key aspects forwarded as barriers for sustainable and energy efficient renovation (Person and Bratt 2010, Olsson *et al*., 2015).

As a consequence, renovation processes tend to repeat themselves. Simultaneously to problems of breaking old habits and structures, and according to Angeuloviski and Carmin (2011) building renovation is a domain were (mitigation) institutions are emerging. Similarly, Gluch *et al*., (2014) argue that, driven by various environmental management systems, energy and environmental work is becoming institutionalized in the Swedish construction industry. The examples provided above witness of a highly complex and institutionalized construction industry, including public building clients, and the problems of disrupting these existing institutions as well as creating new ones (Bresnen 2013; Gluch and Bosch-Sijtsema 2016).

Thus, sustainable renovation faces several challenges in disrupting old and creating new institutions. These challenges, which are governmental, organisational, technological and behavioural, need to be understood at a close range of practices within their context and set in relation with the challenges framed on an industry-field level. This leads us to the institutional work framework which studies institutional dynamics from an agentic and practice-oriented perspective (Lawrence and Suddaby 2006). Examining institutional work in the context of emergent institutional processes, points at actions of those who affect, or attempt to affect, institutional processes at both general and local levels.

Theoretical lens of institutional work

Institutional work is a field of study that refocus institutional studies of organisation to the level of individual and collective actors (Lawrence *et al*., 2011). The concept of institutional work describes "the purposive action of individuals and organisations aiming at *creating*, *maintaining* and *disrupting* institutions" (Lawrence and Suddaby 2006, p.215). Many studies applying institutional theory has foremost focused on the macro-dynamics and macro-perspectives of organizations and change and by doing so overlooked the everyday work of individual actors within the organizations (Lawrence

et al., 2011). In the institutional work framework, an agency perspective with focus on actors (agents) *within an organization* is recognized and researchers are encouraged to alternate the focus on large-scale social transformation and instead focus on the relationship between institutions and the actors who populate them (Lawrence *et al*., 2011).

An agentic and practice-oriented perspective of institutional work may enable an understanding of how interaction between actors, structures, and artefacts shape institutional practices in a specific organizational setting. The research interest lies not in the great accomplishments done by outstanding individuals but rather in the complex, reflexive and recursive relationship the "ordinary" individual expose between themselves as individuals and the institution (s) they encounter or are part of (Lawrence *et al*., 2011). Accordingly, interest is taken in how and why actors work to interpret and translate institutions, and how these actions lead to institutional consequences, where change can be one option but status quo another (Lawrence *et al*., 2011).

A three-level process model to examine institutional change

To introduce a multi-level perspective on institutional change related to management practice for renovation of buildings we draw on the work of Crittenden (2014). Although Crittenden do not explicitly use the term institutional work, his model relates to the key concepts of institutional work and can as such be placed within that field of research. Examining a case of changing energy management practices in Australia, Crittenden has developed a multi-level model of institutional analysis that links individual, organisational and field-level analysis and examines the dynamic process of change over time. The model was developed in response to two main calls; 1) a need for a research design that "bring people back in institutional research", and 2) a need for multi-level studies, thus studies linking micro processes with macro processes, highlighting the links between individual, organisations and the field in institutional research.

In his study Crittenden (2014) adopted a distributed view of agency were focus was on the actors involved in making a decision on whether to support or reject a proposed energy efficiency project. It was found that these decisions were effected by project-, organisational- as well as field-level contexts. Crittenden (2014) therefore argues that a multi-level model is needed to provide insights into the notion of distributed agency as well as provide explanations for the complex nature of organisational fields and the process of change within these fields. The field-level highlights effects from multiple government policies and inter-organisational influences on actions for sustainability management in organisations. As such the model give account for the interactions between multiple stakeholders as they influence institutional change. The organisational level encompasses where sustainability practices are primarily applied. At this level existing practices are disrupted and new practices are developed and maintained. The project level is where the benefit from practices are implemented to deliver tangible outcomes for sustainable development. To support multi-level analysis, the model also exposes skills and strategies of individuals (as agents for institutional work) that influence across the three levels.

METHOD AND CASE DESCRIPTION

A case study method is applied in this paper. Case studies have been shown to capture the process under study in a very detailed and in-depth way and suggested as

suitable for studying complex structures (Dubois and Gadde 2002). In this case study, both a retro perspective and longitudinal perspective will be applied, since we want to explore events in the past as well as investigate the on-going process of change in order to find "triggers" for change at different levels of the organizations and at different times in the change process. The organizational context and analytical unit is the municipal Premises Management Office (PMO) in the City of Gothenburg, Sweden, where a "development-strategy" for renovation is currently being implemented.

The PMO with its 415 employees build, manage and amend municipal premises, including, schools, preschools, housing for elderly and housing for people with special needs. The organization is divided into three divisions: facilities management, maintenance, and building project management. PMO has a staff consisting of functions for HRM, public relations and communication, finance and R&D (including sustainability). The PMO provide premises for public administration in 10 different City Areas (CA) in Gothenburg, which each has separate budgets to follow. The Premises Secretariat (PS), with 7 officials, is responsible for the strategic planning of municipal premises. The Municipal Facilities Board (MFB), which consist of laymen politicians, is deciding focus, goals, policies and directions that governs both PS and PMO's operations. With a four-year budget horizon PS are given investment funding from the MFB which they thereafter allocate to PMO depending on investment needs. For reinvestments into existing buildings PMO get funding directly from the MFB. For the budget period 2016-2019 the size of investment funding was 640 million EUR to be compared with 120 million EUR for reinvestments.

In 2015 MFB assigned the PMO with the task to develop a long-term strategy for renovation of premises built in the 50's, 60's and the 70's. The strategy was sought to be developed together with the stakeholders and include common goals and directives regarding renovation and energy-efficiency in current premises. When fully implemented, the strategy is supposed to, on an annually basis, actively be used in the long-term "plan for maintenance of premises". Maintenance planning will also be made on the basis of the total building stock in the city, hence shifting focus from individual needs of the different City Areas to a having a "city as a whole" perspective. A pilot project was initiated in early winter 2016, in which the strategy will be developed in one City Area. In this Area the strategy is planned to be implemented in autumn 2016.

Empirical data is collected during 2016. At this point (June 2016) data consists of observations of six meetings related to the strategic development plan process. During these meetings, extensive field notes were taken. Additionally, eleven one-hour semi-structured interviews with nine different persons involved in the strategy development process have been conducted. Eight of these interviews were recorded. In addition, the empirical material includes printed material from the presentations, policy documents, written descriptions of the strategy development process and pilot project, organization websites, photo documentation and relevant public documents. Additionally, one of the authors attended a national conference on "Strategic planning of premises" together with representatives from the case organization. Gathered data was converted into text, stored in NVivo and analysed by both authors. For the purpose of this paper, thematic analysis following a multi-level perspective on institutional change was used for analysing the data. As the research is in an initial stage additional interviews and observations are planned for late summer and autumn 2016 and follow-up interviews in 2017.

CASE STUDY FINDINGS

Below, findings from the case study are presented as illustrations on the need to adopt a multi-level and agentic-practice view in understanding purposeful actions of agents in changing renovation management practices for public buildings. From our data we see several interrelations between institutional changes on various levels (examples are illustrated in Figure 1). For example, national as well as local sustainability and energy goals and regulations were found to play a role as an important initial trigger for the idea to develop a "strategic development plan" within a targeted PMO team containing the director, a coordinator (later assigned project-leader), a sustainability official and a consultant. To comply with these requirements, the PMO were forced to reconsider their renovation management practices in several ways. Interesting is that once the idea on a new plan had become a 'reality' the sustainability and energy efficiency aspects seem to be set aside as key issue and goal of the plan and other persuasive aspects were taking over. Thus, just studying "the strategic development plan" on a project level would not have captured this triggering aspect in the change process. Moreover, through a web of influential actions by the targeted PMO team the coordinator at PMO were assigned as project leader. This included to investigate and develop the proposal for a long-term planning process for maintenance of their premises. Once implemented "the strategic development plan" is predicted to have a major impact on every renovation project in the city and as such also renovation management practices within PMO.

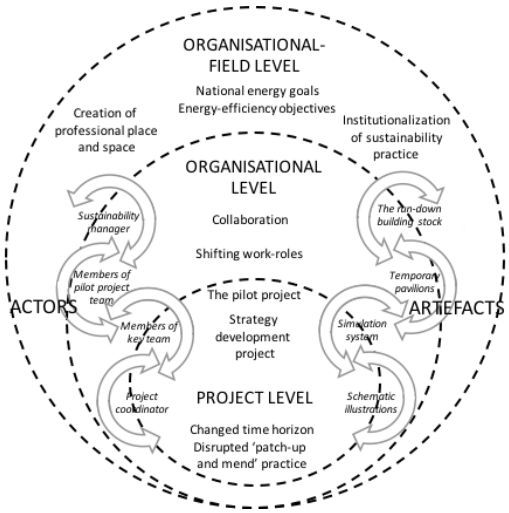


Figure 1: Findings analysed according to a multi-dimensional view on agency for renovation of public buildings

To manage the assignment two new (project) teams were formed, a key project team, responsible for the development plan and a pilot-project team, investigating the new way of working during spring 2016. The idea behind the pilot was "to pave the way" and lay ground for a new renovation management practice. Several interviewees emphasize, wise from previous change processes, the importance of creating legitimacy for the new way of working but also to build organizational trust in that the new way is robust and has enough staying power to last over time, i.e. "keeping the idea alive long enough". The selection of participants in the key project team were done on basis of previous collaboration and people which were seen as 'sensible collaborators', i.e. 'supportive people' that 'understand why this is a much needed action'. The pilot-project team consists of one representative from PMO, one from PS, a 'trustworthy' consultant that for many years been working with both PS and

PMO, and representatives from the city area where the pilot will take place. Within these groups and as potential agents for the initiated change process we have identified three actors performing institutional work across various levels: the coordinator/project leader (of "the strategic development plan" as well as driver of the pilot-project), the director of PMO, and the external consultant. These actors take different agentic roles in the change process; the coordinator as stage-setter and contender of institutional order, the director as supportive provider of organisational space, and the consultant as 'rationality' provider (in terms of graphs and numbers) through the means of an economic simulation system (technology). In his stage-setting within PMO the coordinator used animated power-points with schematic illustrations showing (hoped for) benefits from a changed renovation management practice as well as showing the 'pitfalls' if not acting. At this stage the sustainability official has an "invisible background role", acting through the proxy of the organisation's sustainability goals. As a consequence, sustainability and energy efficiency aspects seem to have become a silent discourse in the project conversations as the close pilot-project team individually' promote their self-interests.

Another example driven by larger institutional changes related to the holistic and long term view of sustainability is the perception of a need to find renovation management practices that counteract the prevailing short term decision culture within PMO. On an organisational level this would entail a shift of focus from having separate plans for different City Areas towards having a 'grand plan' for the city's total public building stock. For the project level this would mean going from a short-sighted 'patch up and mend' practice to a long-term strategic investment view on renovation needs. In addition, one proposition of the 'strategic development plan' is that reinvestments and investments shall be decided on in a combined investment plan, which enforces for an enhanced collaboration between PMO and PS. The suggestion also may imply a reallocation of action as well as power to centrally located construction project managers in PMO. Thus, strategic decisions, previously made by officials at PS, will when (and if) the strategy is realized fully be made by professional construction project managers. In addition, maintenance practitioners, today involved in 'simple patch up and mend' activities will also lose their decision making autonomy as the today's role are suggested to be diminished. Thus, when fully implemented the role of practitioners involved in renovation are believed to change from urgency driven ad hoc fixers to strategic planners and skilled building technicians. All this indicates that shifting institutional logics might take place as a result of the change.

Seen from a field-organisational level the actions taken within PMO are supported by national movements concerning a universal need to reconsider maintenance practice in public building offices. Spaces and places for knowledge exchange, e.g. conferences aimed for public client organisations, is created and give direction for legitimate routes to take. The project-leader, for example, saw here an arena for support and also potential for collaboration with other municipalities facing similar challenges, attend conferences and increase his professional network. In addition, in his rhetoric he used the participation in a conference to internally justify the timely importance of the strategic plan and also to prove "how far they have come" in relation to others.

Analysing the material, also various artefacts emerged as influential non-human agents playing a central role in the ongoing change of renovation management practices, triggering actions. Besides the consultant's simulation system, as mentioned before, the following are two other examples where artefacts/concepts are attributed with rhetorical agency to support change; the run-down building stock and

temporary rented pavilions (i.e. not owned by the city and not under the responsibility of PMO). Both 'objects' dominated the discourse during meetings and were used by the team participants as key arguments for the change. As one project-member describes the building stock: *"[current] renovation-bulge […] is a ticking bomb"*. Another member referred to the problem with a run-down building stock in terms of *"a massive explosive mountain… [*and it is*] an awakening that we cannot shove this mountain in front of us any longer"* and "[now] *comes hell"*. Similarly, the rented pavilions (existing and presumed-planned) became a shared (unwanted) object that helped unifying the pilot project team in their change mission. According to the project members in both the key project team and the pilot project team, the local politicians (which were not members of the groups) were claimed to have a view on pavilions as an attractive alternative to the strategic development plan since the pavilions are rented and do not include investment costs in the short term perspective. Thus, these unwanted objects risk jeopardizing the 'grand plan', as it was said: *"The alternative that we must avoid, is pavilions. It is a challenge to convince the City Areas not to choose pavilions as an option"*. *"We need to present an alternative to pavilions that the politicians can't reject"*. The above examples indicate the importance of not only focusing on human actors as agents of change but also see the role various artefacts play.

CONCLUDING REMARKS AND RESEARCH PROPOSAL

The findings have implied that a consequence from the change process might be increased professionalization within the organization. To assess, plan and decide when a building have to be renovated (or replaced) the practitioners involved in renovation were believed to change from today's urgency triggered ad hoc fixers to trained building technicians, which for some might contest their current professional identity. At the same time our study also indicated a strengthened role for construction project managers within the organization. Changing roles and increased professionalization within the construction industry has, due to an emerging sustainability agenda, been the focus in a few previous studies (e.g. Gluch and Bosch-Sijtsema, 2016: Hughes and Hughes, 2013) but there are still questions to be investigated. Changing professional roles and renovation management practices also raise questions regarding what shifts in institutional logic that underpin change in public construction client organizations? What are the consequences of this professionalization on an organizational-field, organizational, project and individual level?

Findings also indicated that the key project team involved in the strategy project mobilised legitimacy for the new renovation management practice across multiple organisational levels. It also showed that the change was triggered by multiple sources on various levels. This raises questions on how ongoing organising and policy processes on various levels influence and drive sustainable renovation. Thus, the role of various actors' for changed renovation management practices are an interesting aspect for further studies. Herein lies a need to investigate who these actors are and why they are involved? Who are included (and who are excluded)? In our case study we could see that sustainability and energy efficiency aspects in spite of being forwarded as a key stakes from the strategic change process became a 'silent' issue in the 'strategy plan project'. Studying only the strategy plan on a project level would not have captured the sustainability aspect in the change process. Insights on actors' roles raises questions such as how actors negotiate, integrate or collaborate between multiple institutional logics in a public organisation (cf. Bosch-Sijtsema and

Gluch, 2016). How do they collaborate and interact to influence institutionalized practices?

Construction management research articles have so far not studied the agentic role of artefacts and technological objects for institutional work, which is an issue worth further inquiry. Herein lies a need to take into consideration that seemingly stable artefacts can be open to multiple interpretations by different users in the same or different settings (Schweber and Harty 2010). If one focuses only on the role individuals play in a change process, or have a presumption that a tool necessarily and always have a certain role, one fails to see how change is enabled and how institutions are challenged through a socio-technical process involving both actors and artefacts as agents for institutional work. In our study various mediating objects (artefacts) were identified as possible non-human agents, for example simulation tools and unwanted building types. Thus, artefacts are included on the same basis as actors in the conceptual framework suggested (Figure 1). Here socio-technical network approaches could be a viable complementary analytical lens to understand artefacts' agentic role in institutional work. Questions for research might be: Do non-human agents (artefacts) perform institutional work in changed renovation management practice? What active (strategic) roles can these artefacts play in shaping 'purposive action'? Since tools can play different roles in different settings and is largely influences by those using them (Georg 2015), it is important to study effects from tools and other devices at closer range, for example through observations.

The set of critical research issues raised in this discussion and the conceptual model will be in focus for an on-going research project related to sustainable renovation management practices in public construction client organisations.

REFERENCES

Andrews, R N L, and Johnson, E (2016) Energy use, behavioral change, and business organizations: Reviewing recent findings and proposing a future research agenda. *Energy Research and Social Science*, **11**, 195-208.

Anguelovski, I and Carmin, J (2011) Something borrowed, everything new: innovation and institutionalization in urban climate governance. *Current Opinion in Environmental Sustainability*, **3**(3), 169-175.

Bosch-Sijtsema, P and Gluch, P (2016) Interrelation of emergent professionals and institutional processes in project based environments. *EGOS* 2016, July 7-9, Naples.

Bresnen, M (2013) Advancing a 'new professionalism': Professionalization, practice and institutionalization. *Building Research and Information*, **41**(6), 735-41.

Crittenden, P (2014) *New Perspectives on Institutional Change: The Case of Changing Energy Management Practices in Australia*. PhD thesis, UTS Business school, University of Technology Sydney.

Dubois, A and Gadde, L E (2002) Systematic combining: An abductive approach to case research. *Journal of Business Research*, **55**(7), 553-560.

Georg, S (2015) Building sustainable cities: Tools for developing new building practices? *Global Networks*, **15**(3), 325-342.

Gluch, P, Gustafsson, M, Thuvander, L, and Baumann, H (2014) Charting corporate greening: Environmental management trends in Sweden. *Building Research and Information*, **42**(3), 318-329

Gluch, P and Bosch-Sijtsema, P (2016) Conceptualizing environmental expertise through the lens of institutional work. *Construction Management and Economics*, **34**(7-8), 522-535.

Greenwood, R, Oliver, C, Sahlin, K and Suddaby, R (2013) *The Sage Handbook of Organizational Institutionalism*. London: Sage Publications.

Henn, R L and Hoffmann, A J (2013) *Constructing Green: The social Structures of Sustainability*. Cambridge: MIT Press.

Hughes, W and Hughes, C (2013) Professionalism and professional institutions in times of change. *Building Research and Information*, **41**(1), 28-38.

Hoffmann, A J and Henn, R L (2008) Overcoming the social and psychological barriers to green building. *Organization and Environment*, **2**(4), 390-419.

Janda, K B and Topouzi, M (2015) Telling tales: Using stories to remake energy policy. *Building Research and Information*, **43**(4), 516-533.

Lawrence, T B and Suddaby, R (2006) Institutions and institutional work. *In*: S R Clegg, C Hardy, W R Nord and T Lawrence (Eds.) *The Sage Handbook of Organization Studies*. New York: Sage Publications, 215-54.

Lawrence, T, Suddaby, R and Leca, B (2011) Institutional work: Refocusing institutional studies of organization. *Journal of Management Inquiry*, **20**(1), 52-58.

Meyer, M A, Cross, J E, Byrne, Z S, Franzen, B and Reeve, S (2013) Green school building success: Innovation through a flat team approach. *In*: R L Henn and A J Hoffman (Eds.) *Constructing Green: The social Structures of Sustainability*, Cambridge: MIT Press.

Mjörnell, K, Femenias, P, Stenberg, J and Johansson, D (2014) *A Strong Research Environment for Sustainable Renovation Established in Sweden*. World Sustainable Building Conference, 28-30 October 2014, Barcelona.

Olsson, S, Malmqvist, T and Glaumann, M (2015) Managing sustainability aspects in renovation processes: Interview study and outline of a process model. *Sustainability*, **7**(6), 6336-6352.

Palm, J and Reindl, K (2016) Understanding energy efficiency in Swedish residential building renovation: A practice theory approach. *Energy Research and Social Science*, **11**, 247-255.

Palm, J, and Thollander, P (2010) An interdisciplinary perspective on industrial energy efficiency. *Applied Energy*, **87**(10), 3255-3261.

Persson, A and Bratt, M (2010) Det finns potential Energieffektivisera offentliga fastigheter i högre takt. *In*: J Hagetoft (Ed.) *Stockholm: Sveriges kommuner och landsting*.

Schweber, L and Harty, C (2010) Actors and objects: A socio-technical networks approach to technology uptake in the construction sector. *Construction Management and Economics*, **28**(6), 657-674

Thuvander, L, Femenías, P, Mjörnell, K and Meiling, P (2012) Unveiling the process of sustainable renovation. *Sustainability*, **4**(12), 1188-1213.

Thollander, P, Rohdin, P, Moshfegh, B, Karlsson, M, Söderström, M and Trygg, L (2013) Energy in Swedish industry 2020: Current status, policy instruments, and policy implications. *Journal of Cleaner Production*, **51**, 109-117.

vanBueren, E, Broekhans, B and Biggart, N W (2013) Individual projects as portals for mainstreaming niche innovations. *In*: R L Henn and A J Hoffman (Eds.) *Constructing Green: The Social Structures of Sustainability*. Cambridge: MIT Press.

"THE PEOPLE THAT NO-ONE NOTICES"? THE POWER OF BUILDING CONTROL INSPECTORS IN SUSTAINABLE CONSTRUCTION

Niamh Murtagh[1], Loulwa Achkar and Aeli Roberts

Bartlett School of Construction and Project Management, University College London, 2nd Floor, 1-19 Torrington Place, London, WC1E 6BT, UK

In England, national building regulations govern aspects of a building's environmental performance. The profession of Building Control Inspector reviews designs and on-site construction in order to evaluate, and ultimately certify, compliance with the regulations, but little research has been carried out previously to investigate the role of these professionals in sustainable construction. A qualitative study was conducted comprising semi-structured interviews with 20 building inspectors and four key informants from professional bodies in England. The building inspectors tended to position their power as wholly derived from the regulations, thus constraining their contribution on sustainability to regulation enforcement. However, this stood in contrast to their descriptions of day-to-day activities which included providing advice and guidance, effective membership of design teams and a collaborative relationship with contractors/builders, architects and members of the public. Application of French and Raven's (1959; Raven 1992) typology of social influence demonstrates that, in fact, other bases of power are available to, and are used by, building inspectors. The primary conclusion is that, with greater recognition of the varied bases of power available to them, building inspectors could extend their influence in daily working interactions to facilitate more sustainable construction.

Keywords: building control, building regulations, social influence, sustainability

INTRODUCTION

Building control inspectors are part of the construction process on all construction projects in the UK, with the possible exception of very minor domestic works. They are involved in schemes ranging in value from many millions of pounds down to the individual homeowner tackling a do-it-yourself internal re-arrangement. Despite their ubiquity, there has been surprisingly little research with these professionals. Regulation is frequently seen as a primary means of progress towards more environmentally sustainable construction. Given the pivotal role of inspectors in assessing compliance with building regulations, understanding their potential for instigating change is essential for the industry to become more environmentally sustainable. The aim of the current study was to investigate the role of building control inspectors (BCIs) and their potential influence in facilitating environmentally sustainable construction.

[1] n.murtagh@ucl.ac.uk

Murtagh, N, Achkar, L and Roberts, A (2016) "The People That No-One Notices"? The Power of Building Control Inspectors in Sustainable Construction. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1151-1160.

Background

In England, aspects of a building's performance are mandated by a set of legislative instruments, collectively known as building regulations. These are set out in fourteen parts, including structure (Part A), fire safety (Part B), ventilation (Part F), energy efficiency (Part L) and access (Part M). The duty of the BCI is to assess compliance with these regulations. The process of building control proceeds either via plans inspection or building notice. For projects with design plans (typically all projects with the exception of some minor domestic works), the plans are submitted to Building Control prior to commencement of work on site. The BCI conducts an assessment of the plans against regulations, followed by site inspections to assess the work against plan as construction progresses. Alternatively, for small projects, a building notice may be given and the BCI carries out a number of site inspections to evaluate compliance with regulations. In both cases, successful compliance results in the BCI issuing a certificate on completion, which can be important for gaining insurance or mortgage funding. The building control function was originally discharged by local authorities. From the mid-1990s however, private firms were permitted to offer building control services, within a strict framework of accreditation in which evidence of knowledge, capacity, experience, training and insurance is regularly audited. Such firms and their qualified inspectors are known as 'approved inspectors' and the building control function of assessment of compliance is now carried out by approved inspectors and local authority inspectors.

Research studies which have contributed to knowledge on building control have tended to focus on building regulations, particularly on their effectiveness as legislative instruments. Previous work has examined fire safety regulations (Bright, 2007), general compliance with a focus on health and safety (Baiche, Walliman, and Ogden, 2006) and, of particular interest here, energy efficiency (Part L) compliance in research exploring sustainable construction (Bell, Smith, and Palmer, 2010; Pan and Garmston, 2012). There has been consensus in earlier studies that Part L is viewed by BCIs as less important than other regulations (Cox, 2006; Fischer and Guy, 2009; Williams and Dair, 2007). Indeed Boardman (2007: 369) argued that Part L was not seen as "worthy of enforcement" by BCIs. However, such studies were conducted a decade ago. In the interim, the UK Government has enshrined emissions targets in law through the Climate Change Act of 2008; building regulations (particularly Part L) have become incrementally more stringent and further legislation on sustainability in construction, such as the Code for Sustainable Homes, has been introduced (and recently withdrawn). Lipsky (1980/2010) has argued that policy is in fact made by the day-to-day practice of 'street-level bureaucrats', that is, the individuals with responsibility for implementing government policy. Thus an updated investigation with a focus on building control inspectors, rather than on policy instruments, is merited.

Studies on research questions beyond regulations have provided perspectives on BCIs seen through the eyes of other construction professionals. Architects and designers have been found to consider BCIs as a barrier to the inclusion of recyclates in construction design (Chick and Micklethwaite, 2004). Contractors and building performance consultants have questioned understanding of Part L regulations among BCIs (Hamza and Greenwood, 2009). A particularly bleak image emerged from Fischer and Guy's (2009) study with architects, with some of their interviewees suggesting that BCIs are poorly-paid, under-resourced, lacking in skills (specifically on Part L calculations), with a culture that de-prioritises energy efficiency. However,

these are partial perspectives of the wider picture, and differing views on the role of BCIs were discussed within Fischer and Guy's (2009) findings and elsewhere. Good and effective relationships between BCIs and site managers (Baiche *et al*., 2006) and between BCIs and small builders (Sun, Geelhoed, Caleb-Solly, and Morrell, 2015) have been noted. Although good relationships between BCIs and builders could lead to an informality that threatens standards (Geelhoed, Morrell, Caleb-Solly, and Sun, 2012), flexibility and openness to discussion by BCIs are valued by other construction professionals (Killip, 2013). Amongst Fischer and Guy's (2009) architects, some had experience of productive long-term working relationships with approved inspectors, who effectively became part of the design team. The role of the BCI as enforcer of regulations has tended to be taken for granted in previous studies, with Baiche and colleagues (2006) as amongst the few to argue that responsibility for compliance falls to site managers and operatives and that BCIs should be facilitators and certifiers rather than enforcers. In one of the most in-depth studies with building control personnel, and of direct relevance to our research focus on sustainable construction, 59 professionals were interviewed in an investigation of Part L compliance (Cox, 2006) and the mechanisms by which BCIs can wield power were briefly outlined. Distinction was made between local authority and approved inspectors. Both can write letters as an initial sanction to draw attention to non-compliance and can refuse certification. Approved inspectors can refer a case back to the local authority and the local authority can take a case to court, although this is rarely done. It is noted that these mechanisms of power are rarely invoked and that "gentle persuasion" is the preferred means of progress (p. 4).

Theoretical Framework

Despite the focus on weaknesses in compliance in the studies cited, findings show generally high levels of compliance with building regulations, demonstrating that the role of the BCI is by and large successful. However, the implicit assumptions around power as enforcement and the very limited discussion of how BCIs achieve compliance within interactions with other construction professionals ignore long-standing knowledge on the nature of power and influence in social interaction. French and Raven (1959) proposed a model of power in social relations which has been refined subsequently (Raven, 1992) and still remains predominant in social research today (Dörrenbacker and Gammelgaard, 2016, Fiske and Berdahl, 2007). In this model, social influence is defined as a change in an individual's behaviour or belief resulting from the action of another person, the influencing agent. Social power is defined as the potential to wield such influence (Raven, 1992). Social power exists in all human interactions and is invariably implicitly recognised. However, typically, some forms of power are assumed to predominate in particular interactions while others are overlooked. Of the six bases of power proposed in the model, the most easily recognised are those of reward, coercion and legitimacy. Power stemming from the ability to reward is self-evident and coercion is its complement – the power to punish. Threats and rewards may be real, as in the power to award or deny certification of building compliance, but may also be interpersonal – personal approval or disapproval by someone perceived as important to the individual also function as threat or reward. Legitimate power arises, amongst other sources, from a structural relationship, thus the position of building inspector carries formal legitimate power, based on its legislative role, to query, challenge and offer suggestions to others in the design team. Less well-acknowledged bases of power are those of expert and informational power. Expert power lies in the tendency for people to follow the

advice of those they consider experts, in the assumption that the expert has greater knowledge. Informational power relies on access to information or reasoned argument. The sixth power base, referent power, relies on the target of influence identifying with the influencing agent, and is not considered relevant here. Thus French and Raven's model of social influence proposes five bases of power which may be available to BCIs: reward, coercion, legitimacy, expert and informational.

The objective of the research was to explore the role of BCIs in relation to environmentally sustainable construction. Taking a qualitative approach as appropriate for an explorative study, in line with recommended practice we did not begin with a priori theory or expectation. In the analysis stage, we identified French and Raven's theory as a useful framework to aid interpretation of the data and we describe it here as background for the reader.

METHOD

In order to explore the role of building inspectors in depth, a qualitative methodology was adopted. The objective was to gain a broad but nuanced account of how Building Inspectors themselves perceived their role. Semi-structured interviews were conducted with twenty practising building control inspectors and four senior representatives of relevant professional bodies (the Chartered Association of Building Engineers, the Chartered Institute of Building, the Association of Consultant Approved Inspectors and Local Authority Building Control). Half of the participants worked in local authorities and half in approved inspector businesses. The majority of participants were recruited by direct invitation. For the approved inspectors, a list was compiled of all approved inspector organisations. A small number volunteered by responding to a notice on the Planning Portal website. Both businesses and local authorities were selected to ensure a spread of representation across England. No other selection criteria were applied. The interviews were conducted by the second author, lasted approximately one hour and were audio-recorded and transcribed verbatim. Thematic analysis was conducted on the data, following the guidelines of Braun and Clarke (2006). In this method, the transcripts are read and segments of interest coded. The coded segments are then clustered into subthemes and then themes, checking back constantly to the data to ensure completeness and accuracy. In keeping with recognised standards of rigour and validity, data abstracts are presented below to demonstrate transparency and to allow the reader to evaluate the appropriateness of the analysis.

FINDINGS

The themes in the data were clustered into three groups: (1) ensuring basic compliance and the limitations of the role, (2) advising and guiding the design team and (3) a broader vision for the role, and we discuss these first in general below, before considering their applicability for sustainable construction in particular. The reason for this approach is that, although our research focus is on environmentally sustainable construction, this is not a separate element of BCIs' work. The broader picture of how BCIs operate in their day-to-day activities is necessary before examining aspects relating to sustainability in more detail. Verbatim quotations from participants are indicated by number (e.g. P3) to protect anonymity.

Basic compliance and the limitations of the role

The participants described the role of the building control inspector as ensuring compliance with the regulations: to ensure "the building is fit and safe for use" [P5].

Most emphasised the minimal nature of required compliance and many referred explicitly to the boundaries of their role. They clarified that the building inspector's role does not include design. Although they can exercise judgement and consider novel solutions, they cannot instruct changes that have cost implications. Most saw decisions being driven by others: "We're not really a decision maker that, I don't think, that can make a lot of difference…contractors and clients and designers have more of a role to play" [P17]. The sense from many was of the limitations of their role, it being closely aligned to building regulations and with power only to assess (minimal) compliance. These responses clearly considered only the legitimate base of power from French and Raven's (1959) model and perceived this to be a limited form of potential influence.

Advising and guiding

However, an alternative perspective emerged in parallel. A number of participants saw themselves as an intermediary between government policy and industry in terms of knowledge, and spoke of "pass[ing] information on to builders and designers" [P16]. Several mentioned "grey areas" in regulation, where the requirements were not straightforward, and described their role as helping the client. Some noted their collaborative role on the project team, communicating between different professional silos which included communicating design intent to people on site. They typically dealt with the full range of parties involved in a construction project, including clients (from organisational to private householder), structural engineers, architects, site agents, heating engineers, fire officers, builders and site operatives. A number described one of their main objectives as assisting both design team and client:

> Our primary aim is to get the best possible outcome for the building in terms of the client's wishes and the design team's wishes, at the same time as achieving the highest level of compliance…we have two goals. [P12]

The majority saw their role as including the provision of guidance and advice. Most offered technical consultation at a pre-submission stage, to members of the general public as well as to other construction professionals, and their advisory services continued from the early stages of the project right through to on-site work. Some spoke of negotiating, compromising, "an element of advocacy and persuasion" [P7]. A number described making suggestions and offering options or alternative solutions and: "if, for example they can't meet an aspect of the building, we will give them suggestions" [P19]. A strong emphasis on interpersonal skills and an ability to communicate and negotiate was evident. Some participants explicitly contrasted the typical approach with an earlier or stereotypical role of 'police officer': "We need to advise and be advisory because the world has changed and customer expectations have changed. Nobody, a householder, or whatever, will tolerate anybody wielding a big stick from the public authority" [P7]. Here the participant makes reference to what the social power model would term coercive power and interestingly, the reference relates to the ineffectiveness of this power base.

A few participants recognised the influential nature of the role of building inspector:

> That influence is real… the small to medium sized contractors, they will defer to a building control officer for the simple reason that they want to get a building built … and they will give him his place". [P2]

Although one participant felt that "we're the people that no-one notices", he then went on to note the significant impact of building control on the sector: "For the industry, we have a huge impact on the built environment, huge…without us, it wouldn't be

possible" [P12]. So although the bounded nature of their role was salient for the participants, they also described the guidance and advice they offered and the processes of discussion and communication they used, with a few recognising the considerable influence of their profession. From the perspective of social power theory, the BCI possesses expert and informational power as well as institutional, and the evidence here suggests that these forms of power are exercised by BCIs on a day-to-day basis, albeit often without full recognition.

Broader role

Despite the emphasis from the majority on the constraints of their position, some participants showed a broader vision of the potential of the building control role. Noticeably, a few did not accept the limitation of minimal compliance with regulations, speaking instead about contributing to high quality in construction: "I think [the role of building control is] to support the construction industry in getting the quality of building construction as high as possible" [P7]. Others described being pro-active in their approach within the limits of ensuring compliance. Some participants noted the wider role of the building control sector, contributing to British Standards for example, and others saw the potential for this to be expanded and to include input to regulations.

Sustainable construction

The research aim of the study was to develop deeper understanding of the role and power of BCIs to facilitate more environmentally sustainable construction so we turn now to focus on responses relating to sustainability. Before considering the three themes with specific respect to sustainable construction, two preliminary points are necessary, regarding the participants' interpretations of the term 'sustainability' and their perspective of the relative importance of regulations addressing sustainability.

The interviewees provided a broad range of responses when asked what they understood by the term 'sustainable construction'. Most referred to energy efficiency and thermal performance. Some referred to flooding, biodiversity, water efficiency, waste and materials. Several saw sustainability in terms of durability, linking the term to high quality, flexible buildings that were useful to their occupants and to society over time. A number spoke about the bigger picture and global context. For most participants then, there was a holistic understanding of sustainability in construction, not restricted to the aspects addressed in current building regulations.

Participants were asked if all regulatory parts were of equal importance, in order to assess the relative priority of environment-related provisions. There was consensus that compliance with all parts were required but that primary attention may be paid to some provisions. As Participant 12 explained: "We can't sign a building off unless we're satisfied that every, single building regulation is at a satisfactory standard, but naturally, you get drawn towards certain regulations because of the impact they have". For most participants, fire and structural safety were the parts that were first mentioned although a few also referred to Part L on energy efficiency as high priority. In contrast, others described the difficulty of communicating the importance of Part L to the client due to its intangibility and complexity. This suggests a somewhat complex take on the regulations by BCIs: the experience of an implicit hierarchy of importance influenced by risk and tangibility alongside recognition of the equal statutory footing of all provisions.

Responses to their role in sustainable construction showed a similarly diverse range to views on the role in general. For some participants, the fundamental role was that of compliance with Part L, and more generally to implement government policy. A number clearly articulated what they perceived as the absolute limitations of their role, seeing no involvement without the existence of legislation: "The only way building control could make [construction more sustainable] is to get it within the legislation as set standards, otherwise we can't really enforce anything" [P5].

However, several participants juxtaposed acknowledgement of some power on aspects of sustainability alongside the constraints. For example,

> We can't influence design and we can't influence how things are done, but then when people are talking to us about renewable energies… is guiding them through various options that are available to them". [P9]

One spoke of an "advocacy role" in encouraging the client and designer to improve thermal performance so that energy bills were reduced. Another mentioned scope for advice given the flexibility in thermal modelling for projects. So there was reference to influence beyond ensuring that the regulations are met. However, although referred to, in most cases, this influence remained partially unrecognised. For example, one said:

> They could perhaps say in the process of value engineering and so forth that they might want to think about this or … that, but it's nothing that we have any power to enforce, it's all sort of goodwill". [P21]

In these extracts, the participants show awareness of the expert or informational power of their role but appear to acknowledge only the coercive power base – other forms of influence are dismissed as "goodwill".

When asked about the contribution that the building control professional could have, participants proposed multiple ways for the sector to facilitate progress of sustainable construction. Reference was made to the ability of building inspectors to "push the boundaries" [P9] and to facilitate the introduction of alternative technologies and methods; to apply their knowledge for more holistic solutions, "to encourage people to think" [P16]. There was recognition of the potential to encourage others on construction projects to set and achieve higher standards with respect to the environment and generally "to promote good practice in terms of build and materials" [P14]. One key informant felt that building control had the potential to influence the industry in general and could encourage development of government policy. Another BCI clearly described the constraints of the role but went on to describe his efforts on a flagship project, intended to demonstrate excellent practice. Thus, despite near universal recognition of the limitations of institutional power of their role, that is, French and Raven's legitimate power base, almost all were deploying expert and informational influence in their day-to-day interactions, and a number were actively looking for other ways to influence the industry.

DISCUSSION

Based on our analysis of interviews with twenty-four building control professionals, the findings suggest that most considered their role in sustainable construction to be limited by the content of building regulations. However, this perspective overlooked the processes by which BCIs in fact operate. In parallel with describing the constraints of their role, the participants also describing informing, advocating, persuading, guiding and influencing, as essential mechanisms to accomplish their job objectives.

From the perspective of the social power model (French and Raven 1959; Raven 1992), their responses appeared to consider primarily the formal legitimate power base, that is, the power based on the regulatory role of the building control inspector. Limited comment was also made on coercive power – the power to punish, in this case by not signing off on compliance. An approach based primarily on coercive power was seen to be likely to meet resistance and to be ineffective. An analysis of power bases by Raven and colleagues (1998) found a two factor solution: (1) 'harsh' forms of power including power from legitimate position and use of sanctions, and (3) 'soft' forms including expert and informational. The responses from our participants recognised harsh forms of power almost exclusively. However, soft forms of power were in evidence.

In particular, participants referred to informational power in which they proffered suggestions to the design team, and to expert power, in which their knowledge and experience contributed to project outcomes. While on the one hand the participants described how they used these forms of influence, on the other hand, they appeared to dismiss them, in one case describing them as just "goodwill". Research has shown these 'soft' forms of power to be, in general, more effective than harsh forms, with expert power particularly effective across domains (Fiske and Berdahl, 2007). A small number of participants appeared to realise the expert power of BCIs and had planned, or could see potential, to drive flagship projects or to influence government policy. For a few, their expert power was consciously incorporated into their daily job, in their attempts to move beyond the minimal requirements of the regulations and to encourage higher standards. Building on the insights of French and Raven, more recent work has examined tactics of influence (Yukl and Falbe, 1990), and techniques such as rational persuasion and inspirational appeal (Wichmann *et al* 2016) may be appropriate for BCIs. Further empirical work is required to investigate further.

The findings here align with the arguments of Fischer and Guy (2009) on the potential role of the 'intermediary'. Although examining the role of the architect, they proposed the importance of the intermediary, who could mediate not only between the technical requirements of regulations and the design team, but could also mediate between constructions professionals. The BCIs here described their relationships with multiple players within the design team and beyond, and referred to conveying knowledge and expertise – about the design intent, about the regulations and about construction techniques in general – amongst the range of project stakeholders. Fischer and Guy argued for the architect to assume the important role of intermediary in sustainable construction. We argue that BCIs are also ideally placed to take on this role. Indeed, BCIs may be better placed given their independent position and their frequently greater presence on site. This proposition could be explored further in future research which examines the perspectives of other construction professionals on BCIs.

The findings challenge earlier research which argued that Part L of the building regulations was seen as less important by BCIs. The participants in this study were clear that all regulations were important. Even if some appear to be primary, the participants noted that, in reality, it is highly unusual for regulations to be prioritised – compliance with all relevant parts must be achieved. As the earlier studies were completed a decade ago, it is possible that understanding of the importance of Part L has developed in the interim. The current study also contrasts with that of Baiche and colleagues (2006) in which the participant BCIs suggested that the regulations were straightforward to interpret. Here, the 'grey areas' of regulation which required the

BCI's interpretation were mentioned by several, as was the complexity of Part L in particular. Again, the passage of time and evolution of the regulations may explain the difference in findings.

CONCLUSIONS

The power available to BCIs goes beyond that of the formal legitimate power of the role and the coercive power to refuse certification of compliance on a building project. Although these are the forms of power most often referred to, in reality, the BCI's role in ensuring compliance is typically achieved through expert and informational power, deployed through advice and guidance. There is great potential for BCIs to become more influential in encouraging increasing levels of sustainability through realisation of all of the power bases they wield and how they can use them most effectively. This potential is understood, and acted upon, by some BCIs but could be deployed much more widely. Decades of theory and research on social power point to bases of power and means of effective use (the influence tactics mentioned above) which could enable BCIs to leverage the power of their role to contribute more to progress in sustainable construction.

REFERENCES

Baiche, B, Walliman, N and Ogden, R (2006) Compliance with building regulations in England and Wales. *Structural Survey*, **24**(4), 270-99.

Bell, M, Smith, M and Palmer, J (2010) *Review of the implementation of Part L 2006* BD 2702, London: Department of Communities and Local Government.

Boardman, B (2007) Examining the carbon agenda via the 40% house scenario. *Building Research and Information*, **35**(4), 363-75.

Braun, V and Clarke, V (2006) Using thematic analysis in psychology. *Qualitative Research in Psychology*, **3**(2), 77-101.

Bright, B (2007) Whose job is it anyway? *Fire and Safety Engineering*, **14**(9), 27-8.

Chick, A and Micklethwaite, P (2004) Specifying recycled: Understanding UK architects' and designers' practices and experience. *Design Studies*, **25**, 251-73.

Cox, C S J (2006) *Compliance with Part L1 of the 2002 building regulations ED02302*, Online: The Energy Efficiency Partnership for Homes.

Dörrenbacker, C and Gammelgaard, J (2016) Subsidiary initiative taking in multinational corporations: the relationship between power and issue selling. *Organizational Studies*, 1-22.

Fischer, J and Guy, S (2009) Re-interpreting regulations: Architects as intermediaries for low-carbon buildings. *Urban Studies*, **46**(12), 2577-94.

Fiske, S T and Berdahl, J (2007) Social power. *In*: A W Kruglanski and E T Higgins (Eds.) *Social Psychology: Handbook of Basic Principles*. New York: Guilford.

French, J R P and Raven, B H (1959) The bases of social power. *In*: D Cartwright (Ed.) *Studies in Social Power*, Ann Arbor, Michigan: Institute for Social Research, 150-67.

Geelhoed, E, Morrell, A, Caleb-Solly, P and Sun, M (2012) Exploring the complexity of understanding, managing and marketing codes for sustainability in the current economic climate - issues for the small builder. *In*: N M'sirdi, A Namaane, R J Howlett and L C Jain (Eds.) *3rd International Conference on Sustainability in Energy and Buildings*, Marseilles, France, Vol. 12, 63-73.

Hamza, N and Greenwood, D (2009) Energy conservation regulations: Impacts on design and procurement of low energy buildings. *Buildings and Environment*, **44**, 929-36.

Killip, G (2013) Products, practices and processes: Exploring the innovation potential for low-carbon housing refurbishment among small and medium-sized enterprises (SMEs) in the UK construction industry. *Energy Policy*, **62**, 522-30.

Lipsky, M (1980/2010) *Street-Level Bureaucrats: Dilemmas of the Individual in Public Services*. New York: Russell Sage Foundation.

Pan, W and Garmston, H (2012) Building regulations in energy efficiency: Compliance in England and Wales. *Energy Policy*, **45**, 594-605.

Raven, B H (1992) A power/interaction model of interpersonal influence: French and Raven thirty years later. *Journal of Social Behavior and Personality*, **7**(2), 217-44.

Raven, B H, Schwarzwald, J and Koslowsky, M (1998) Conceptualizing and measuring a power/interaction model of interpersonal influence. *Journal of Applied Psychology*, **28**(4), 307-32.

Sun, M., Geelhoed, E, Caleb-Solly, P and Morrell, A (2015) Knowledge and attitudes of small builders toward sustainable homes in the UK. *Journal of Green Building*, **10**(2), 215-33.

Wichmann, B K, Carter, C R, Kaufmann, L and Wilson J R (2016) Making environmental SCM initiatives work: Moving beyond the dyad to gain affective commitment. *Journal of Supply Chain Management*, **52**(1):21-40.

Williams, K and Dair, C (2007) What is stopping sustainable building in England? Barriers experienced by stakeholders in delivering sustainable development. *Sustainable Development*, **15**(3), 135-47.

Yukl, G and Falbe, C M (1990) Influence tactics and objectives in upward, downward and lateral influence attempts. *Journal of Applied Psychology*, **75**(2):132-140.

A COMPARATIVE STUDY OF BIOMASS ENERGY TECHNOLOGIES FOR SUSTAINABLE ELECTRICITY IN NIGERIAN RURAL AREAS

Abdulhakeem Garba[1], Mohammed Kishk and David R Moore

Scott Sutherland School of Architecture and Built Environment, Robert Gordon University, Garthdee Road, Aberdeen, AB10 7QB, UK

Biomass as a Renewable Energy Technology (RET) is used to provide sustainable electricity to rural areas in several developing countries. As a result of dwindling power generation and supply in Nigeria representing between 10 and 34%, the rural communities have been negatively affected in their socio-economic activities. Considering the vast biomass resources in Nigerian rural areas, it is feasible to provide sustainable electricity to these communities through Biomass Energy Technologies (BETs). However, cost has been found to be a major constraint in adopting BETs. The research aims to evaluate the economics of BETs in generating sustainable and affordable electricity in Nigerian rural areas. Whole Life Costing (WLC) approach has been used to evaluate various capacities of BETs. All the BETs capacities evaluated except 50kW combustion system are cost competitive with existing fossil fuel sources used in generating electricity in Nigeria at US$0.13 without incentives. In the event of biomass fuels price increases between 50-100%, WLC/kWh of some scenarios will exceed the existing electricity tariff.

Keywords: biomass energy technologies, Nigeria, sustainable electricity, whole life costing

INTRODUCTION

Sustainable power generation and supply is seemingly unachievable in Nigeria despite the country's abundant fossil fuel and renewable energy resources (Energy commission of Nigeria (ECN) 2005). The reasons for this inconceivable problem include high gridlines network loses of around 40% especially in Nigeria, investment imbalance of energy infrastructures (World bank 2005; Garba and Kishk 2014) and the electricity generation cost using fossil fuel (FF) sources in the country is in excess of US$ 1,000/kW (Eberhard and Gratwick 2012). Also, there is a high investment cost factor in extending the gridline network to rural communities as they are low income earners, have low capacity utilisation and are typically a long distance from load centres, making it unattractive to investors in providing electricity to these communities (Garba and Kishk 2015; Sambo 2009).

Nigerian electricity generation and supply still represents around 4,000MW or less for a population of approximately 170 million despite completion of the privatisation of power sector in 2013 (Garba and Kishk 2015). While electricity accessibility in the country remains at 34% and 10% for urban centres and rural areas respectively (Garba

[1] hakeemgarba@gmail.com

Garba, A, Kishk, M and Moore, D R (2016) A Comparative Study of Biomass Energy Technologies for Sustainable Electricity in Nigerian Rural Areas. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1161-1170.

and Kishk 2014), rural communities represent two-thirds of the total country's population, the implication therefore is that majority of the population have little or no access to electricity and have to source for alternative means to meeting their energy needs. For example, fuel wood and charcoal consumption in the country constitutes over 50 million tonnes annually (Sambo 2009; Ikeme and Ebohon 2005). This energy deficiency has affected the socio-economic setting of the rural communities, with income typically below US$1.25/day (UNICEF 2011).

Hence, rural communities' electricity needs have to be met through sustainable and economical means, typically the renewable energy technologies (RETs) particularly its decentralised system (with less or no gridlines network and without fossil fuel sources). This is because RETs have been used in providing sustainable electricity to rural areas in developing countries. Also, decentralised RETs has merits in determining when and where power energy is truly required; helps in mitigating greenhouse gas (GHG) emission associated with FF and creates more employment especially biomass source (Evans *et al*., 2010). The most used in this respect includes solar PV, biomass and small hydropower systems (Mahapatra and Dasappa 2012).

Studies have been conducted in respect of sustainable electricity provision to rural areas in developing countries using decentralised RETs. Typically, the study by Dasappa (2011) reported that biomass is among the optimal alternative energy sources for sustainable electricity provision in Sub-Saharan Africa (SSA) given the universal availability of the resources. Demirbas (2001) argued that biomass energy technologies (BETs) are cost competitive with fossil fuel sources. Mahapatra and Dasappa (2012) reported on the whole life costing (WLC) of biomass, solar PV and grid extension systems. The study concluded that biomass is the most economical means of providing sustainable electricity to Indian's rural areas. They further argued that BETs (gasification) has significant advantage over solar PV system that requires only additional fuel as operational hours increases, but "the increase in its load demand does not require increase in the gasifier rating, as the gasifier turndown ratio is quite high". While in the case of solar PV "as the operational hours increase, the system size also increases and consequently, its capital cost". Also, Garba and Kishk (2014) evaluated six major RETs (solar PV, wind, small hydropower, biomass, geothermal and ocean energy systems) using systematic review method, and a SWOT analysis for each RET was carried out in order to assess their sustainability indicators. The findings by order of priority revealed that biomass, solar PV, small hydropower and wind are the best means for providing sustainable electricity in Nigerian rural areas. However, Evans *et al*., (2010) argued that BETs are cheaper than solar PV but more expensive than grid extension system. Hence, from the above, it is fair to conclude that BETs are the best means of electricity provision in rural areas.

Similarly, through the BETs application, it is feasible to reduce greenhouse gas (GHG) emission globally particularly from the construction industry given it's consumption of around 40% of all energy and contribute approximately 30% of global GHG emission annually (Lemmet 2009). Construction practitioners should encourage the use of BETs (using biomass boilers and gasifiers) for providing low carbon energy on site and during utilisation of completed project particularly water heating and cooking which accounts for over 80% of the total residential accommodation energy consumption in cold climates (Mandelli *et al*., 2016) as against use of FF sources.

This study builds upon Garba and Kishk (2014) and Oyedepo (2012) recommendations that WLC evaluation of RETs in Nigeria should be conducted given

the lack of reliable cost data which has affected modern RETs inclusion in the country's energy mix. Hence, this study aims to evaluate and optimize the economics of BETs in generating sustainable electricity in Nigerian rural areas.

Biomass resources and energy system

The majority of biomass resources are located close to rural areas and includes agricultural crops and their residues, animal dung, forestry residues, other energy crops, and municipal solid waste (IRENA 2012). Biomass is mostly plant derived materials, capable of being transformed to different forms of energy (electricity, heat and fuel) and can quickly be regenerated in different environments (Evans *et al*., 2010).

Martinot (2015) reported that biomass is the fourth largest energy source after oil, coal and natural gas. By the end of 2014 bio-power global capacity was around 93 Giga watt (GW) and 75% of electricity generated from biomass was from solid biomass fuel, biogas (17%), MSW (7%) and biofuel (1%). Also, by the end of 2014, all the existing bio-power systems together produced around 1.8% of global electricity.

Nigerian biomass resources potential

According to ECN (2005) Nigeria's estimated biomass resources consumption per annum is around 144 million tonnes. Dasappa (2011) projected Nigeria's biomass resources (30% forest and agricultural residues) availability is capable of resulting into a 15,000MW capacity. It is possible to generate up to 68,000 GWh/year using only one-third of biomass resources for the country's rural communities (Garba and Kishk 2014). The forest resource is the largest biomass utilized in Nigeria for energy purposes. Biomass resources can be used to provide electricity in Nigerian rural areas without a supply chain issue; however, its supply chain should be given emphasis before adoption in these communities as it determines its cost (IRENA 2012).

Biomass energy conversion technologies

BETs conversion systems are classified under two main sections: thermochemical (combustion, gasification and pyrolysis) and biological (anaerobic digester). All the identified BETs will be evaluated except Pyrolysis. This is because "there are no commercial plants for electricity production using pyrolysis process" at the moment (Gonzalez *et al*., 2015).

Direct Combustion (DC) converts biomass materials to heat and electricity through production of steam in a furnace or boiler and use to drive steam turbine for electricity generation (Demirbas *et al*., 2009). Miguez *et al*., (2012) classification based on system capacity include: fixed bed (less than 40kW), moving grate (between 40-150kW) and retort system (greater than 150kW). For the purpose of this study, (maximum capacity of 150KW) both fixed bed and moving bed grate have been selected for evaluation.

Gasification system (GAS) converts biomass through partial oxidation into a gaseous mixture of syngas/product gas consisting of hydrogen, carbon monoxide, methane and carbon dioxide (Wang *et al*., 2008). The producer gas (PG) is of low caloric value containing from 4-6 MJ/kg compared to natural gas having 35-50 MJ/kg due to high nitrogen presence in excess of 50%. The electricity generation from a small scale GAS plant is exclusively via Internal Combustion Engines (ICE), at the moment (Bocci *et al*., 2014). GAS is mainly classified into fixed bed, fluidised bed and entrained flow gasifier. Considering the low energy utilisation of rural communities

only the downdraft -fixed bed gasifier is suitable for small scale power generation ranging from 10 kW to over 100 kW and has been fully commercialised (IRENA 2012).

Anaerobic digestion (AD) is a biological process of generating electricity via conversion of biomass resources with moderate moisture content into biogas. IRENA (2012) opined that multiple feedstocks co-digestion is the best and generally practiced strategy in achieving good biogas. Biogas is a mixture of methane and carbon dioxide with other constituents, and is mostly burned in ICE or gas turbine for electricity generation at a capacities range between 10kW - several MW (IRENA 2012).

METHODS

The purpose of this paper is to evaluate the economics of BETs in generating sustainable electricity in Nigerian rural areas. Whole life costing (WLC) approach has been used to achieve this objective, as it seeks to "optimize the cost of acquiring, owning and operating physical assets over their useful lives by attempting to identify and quantify all the significant costs involved in that life, using the present value technique" (Woodward and Demirag 1989). In addition, WLC is suitable for both selections between mutually exclusive options and in ranking among the same set of investment alternatives. Though, it has been criticized for not taking into account returns and benefits of investment. It does allow for determining the unit cost of generating electricity from an energy source.

The WLC framework proposed by Mahapatra and Dasappa (2012) has been adapted and modified for use in the current study, as it can accommodate energy systems that require continuous fuel utilization such as biomass resources. The carbon trading incentive in this framework is not applicable in the Nigerian power sector at present; as such it has been replaced with a Feed-in-Tariff (FIT) incentive strategy in the country (details shown in table 2). Salvage value and inflation are not considered in this study for ease in decision making. The WLC framework is given by:

$$\text{WLC} = \frac{C_G + C_E + (C_F + C_M) \times P(d,n) + C_R \times P(d, n_1) - FIT \times P(d,n)}{L \times h \times n}$$

Where CF= (SC x fcon x h x fC), CM = (SC x f x MC), FIT = (L x h x n x I)

CG = capital cost of primary converter (PC), CE = capital cost of engine/generator, CF = annual fuel cost, CM = annual maintenance cost, SC = PC rating (kg), fcon = fuel consumption (kg/h), fC = unit fuel cost, MC = maintenance cost of the system, P = present worth factor, d = discount rate, n= life of the project, n1= life of each component, CR= component replacement cost, FIT = annual feed-in-tariff benefit, I = incentive benefit, h = annual operation hours, L = load (kW).

The system boundary for this study is a capacity not exceeding 150 kW. The costs of all the conversion components were sourced from the manufacturers directly. This is because, while existing literature reported widely varying figures; this did not change in this context as variations are a result of, size, location factor and technology maturity. While GAS is an emerging technology, location factors (more expensive in Europe and America but cheaper in India) are emphasised by the study of Breeze (2014) and O'Connor (2011); and Ganesh and Banerjee (2001) confirmed that "gasifiers cost in India is much lower than those elsewhere". AD components costs were only obtained through a turnkey procurement process as manufacturers are reluctant to participate under the traditional approach and small capacities.

The current prices of the biomass feedstocks have been obtained directly from the market (field survey of marketers), their weights measured and subsequently converted to unit cost/tonne. The total price of the wood supply chain including transportation is US$112.50 representing 45 units as classified in the market and each unit is approximately 105kg and sold around US$3.00. Hence, the unit cost of wood fuel is US$ 28.57/tonne. This principle has been adopted for other fuels utilised. See details of the prices, fuel consumption pattern and other parameters utilised in table 1where all costs are presented in US$ for universal understanding, even though the costs have been obtained in India Rupee (INR) for GAS and AD systems, and Chinese Yuan for DC system. It is noteworthy that 200 Nigerian Naira is exchanged for US$1

Table 1: The parameters utilised

Factors	Combustion	Gasification	Anaerobic Digestion
Biomass Technology Cost (US$/KW)	1,427 -2,247	1,280 - 2,470	3,529 - 6,451
Fuel Consumption/Kw (kg/hr)	50kw -8.6 100kw-5.4, 150kw -4.30	Wood - 1.4 Cereal Straw 2.9	Cattle Manure -2
Fuel Cost (US$/kg)	Wood - 0.029	Wood - 0.029 cereal straw - 0.03	Manure - 0.015
Life span of Primary Conversion system	Boiler -25 yrs	Gasifier - 15 years	Digester - 25 years
Life span of secondary conversion system	ST -25 years	ICE - 7.5 years	Engine -13 years
Energy Consumption	Fixed -36kW	20% -syst cap	20% -syst cap
Engine replacement	NA	1	1
Discount Rate	13%	13%	13%
Annual Maintenance cost (US$/ kW)	0.024	0.024	0.027

Table 2: FIT Model in Nigeria (Whole Contract Prices N/kwh) (NERC 2013)

	2012	2013	2014	2015	2016
SHP	23.56	25.43	27.46	29.64	32.00
Wind	24.54	26.51	28.64	30.94	33.43
Solar	67.92	73.30	79.12	85.40	92.19
Biomass	27.43	29.62	32.00	34.57	37.36

DATA ANALYSIS

BETs investment cost in Nigerian rural areas

Table 3 indicates the capital cost/kW for DC, GAS and AD systems ranging between US$ 1427 -US$2,247, US$ 1280 – US$2489 and US$ 3,529 – US$6,451 respectively. DC conversion components prices appears to be the most stable, because the system has been in existence for a long period of time. Martinot (2015) depicts that DC has been utilised for a long time and over 90% of the biomass electricity generated is from this system. AD is identified as the most expensive technology and cost/kW of the AD system capacities double the rates of the remaining BETs (DC and GAS) system capacities. The high cost/kW identified under all of the AD system capacities relates to the turnkey procurement route typically used. The economy of scale noticed in the exercise, is indicative that the higher the BETs capacities, the lower the cost/kW.

Table 3 also reveals the cost structure associated with BETs. The conversion systems together with their associated fittings and accessories account for between 90% -96% of the total investment cost. While other cost factors such as civil and electrical works make up the balance. It is noteworthy that the primary conversion systems (gasifiers, boilers and digesters) account for average of around 58% of the investment cost across the board; while generators average cost is approximately 34%.

Table 3: The Cost/kW of BETs systems in Nigeria's rural areas

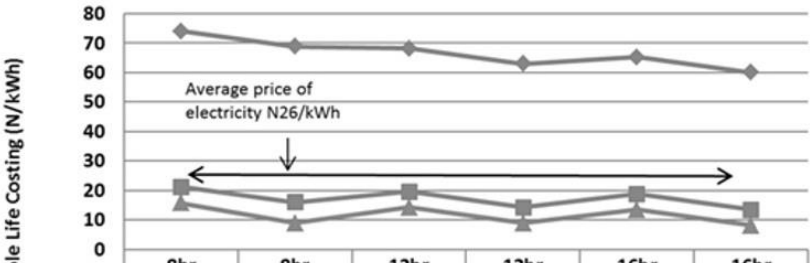
Direct Combustion (DC)				Gasification (GAS)							Anaerobic Digestion (AD)				
Boiler				**Gasifier**							**Digester**				
Capacity (kW)	**50**	**100**	**150**	Capacity (kW)	**10**	**24**	**32**	**50**	**100**	**125**	Capacity (kW)	**10**	**20**	**50**	**100**
Boiler Plant	32,525	32,937	57,115	Gasifier and accessories, chiller, wood cutter, dryer	14,301	20580	27,657	41,202	79,317	95,067	Biogas Plant and accessories (pumps, tanks & heaters)	51,000	83,000	171,000	290,000
Accessories and Fitting	12,500	13,200	13,200												
Cost of Boiler & accessories	**45,025**	**46,137**	**70,315**	**Cost of gasifier & accessories**	**14,301**	**20,580**	**27,657**	**41,202**	**79,317**	**95,067**	**Cost of digester & accessories**	**51,000**	**83,000**	**171,000**	**290,000**
Steam turbine				**ICE**							**Biogas Generators**				
Steam turbine and accessories	57,377	81,967	127,868	Gas Engine & accessories	6,599	11,920	14,443	21,798	44,183	53,433	Biogas engine	7,300	10,600	24,500	46,700
											H2S and moisture s	1,300	1,600	2,200	3,000
											Parking charges	900	1.100	1.400	1.700
Cost of steam turbine & accessories	**57,377**	**81,967**	**127,868**	**Cost of ICE & accessories**	**6,599**	**11,920**	**14,443**	**21.798**	**44,183**	**53,433**	**Cost of ICE & accessories**	**9,500**	**13,300**	**28,100**	**51,400**
Total cost of boiler & turbine	**102,402**	**128,104**	**198,183**	**Total cost of gasifier & ICE**	**20,900**	**32,500**	**42,100**	**63,000**	**123,500**	**148,500**	**Total Cost of digester & Generator**	**60,500**	**96,300**	**199,100**	**341,400**
Others				**Others**							**Others**				
Installation + commissioning	2,500	2,500	3,000	Installation + commissioning	1,000	1,000	1,000	1,000	1,500	1,500	Installation + commissioning	2,500	2,500	3,000	3,000
Civil works	2,000	2,000	2500	Civil works	1,500	1,500	1,500	1,500	2,000	2,000	Civil works	-	-	-	-
Earthing work	350	400	400	Earthing work	300	300	300	300	400	400	Earthing work	-	-	-	-
Price & Design Risk (5%)	5,120	6,405	9,909	Price & Design Risk (5%)	1,185	1,765	2,245	3,290	6,370	7,620	Price & Design Risk (2.5%)	1,513	2,408	4,978	8,535
Total cost of the system	**112,372**	**139,409**	**213,992**	**Total cost of the system**	**24,885**	**37,065**	**47,145**	**69,090**	**133,770**	**160,020**	**Total Cost of the system**	**64,513**	**101,208**	**207,078**	**352,935**
Cost/kW (US$)	**2,247**	**1,394**	**1,427**	**Cost/Kw (US$)**	**2,489**	**1,544**	**1,473**	**1,382**	**1,338**	**1,280**	**Cost/KW (US$)**	**6,451**	**5,060**	**4,142**	**3,529**

Unit cost of biomass electricity in Nigerian rural areas

Figure 1 reveals typically the WLC/kWh of generating electricity from DC; while GAS and AD systems results will only be analyzed in this section; as their figures cannot be presented due to space constraint. Under DC, 3 system capacities and 3 categories of operational hours have been considered.

The findings show that both 100kW and 150kW scenarios have WLC/kWh ranging from US$ 0.068 – US$0.11 without incentive; while with FIT the prices reduce significantly to US$0.041 – US$0.08. Both scenarios are competitive with the current electricity tariff in the country using FF options (US$ 0.13/kWh).

However, WLC/kWh for 50kW with its 3 operational hour's categories, with and without incentive, varies from US$0.30 – US$0.37. This cost range is significantly higher (over 100%) than the existing electricity tariff in the country. Also, even the usage of incentive in this case does not affect the cost in any way. The electricity consumption under all of DC system in this case is fixed (36KW) as highlighted in table 1 and has significant impact on these scenarios, particularly 50 kW. Typically, 50kW minus 36kW, the owner/investor has been left with only 14kW capacity electricity. But as you go higher the efficiency increase. More so, the fuel consumption of the 50kW scenario is the highest among all the BETs and capacities considered in this study, with over 8kg/kWh.



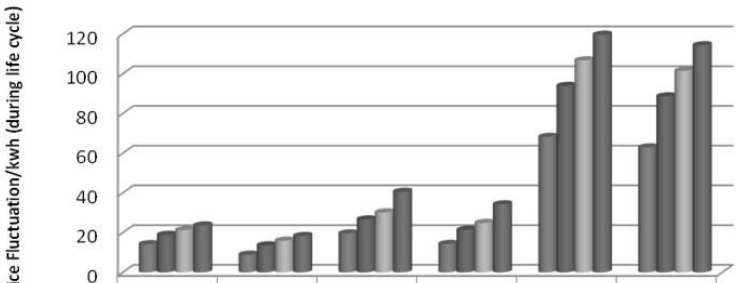
	8hr operation NFIT	8hr operation WFIT	12hr operation NFIT	12hr operation WFIT	16hr operation NFIT	16hr operation WFIT
50kW	74.08	68.78	68.21	62.92	65.29	59.99
100kW	21.26	15.96	19.62	14.32	18.8	13.5
150kW	15.71	8.93	14.23	8.93	13.49	8.19

Figure 1: WLC/kWh of Direct Combustion systems in Nigerian Rural Areas (typical)

In the case of GAS and AD, 6 and 3 system capacities have been considered respectively; and 3 each operational hour are utilised. The WLC/kWh for generating electricity under GAS (125KW – 10kW) with FIT is between US$0.015 – 0.07, while without FIT is between US$0.05 – 0.11. In the case of AD (100kW – 10kW) with and without FIT is respectively between US$0.02 – 0.10 and US$0.046 – 0.13. In both GAS and AD systems, none of the scenarios exceed the current electricity tariff in the country using FF sources (US$0.13).

Sensitivity analysis

In view of competing alternative uses of the biomass resources, there is a likelihood of feedstock price inflation. Also, given the lack of statistics in respect of biomass resource prices in relation with biomass electricity generation in the country, and the importance of feedstock over the total cost (50%) of unit of electricity generated through BETs (IRENA 2012), this section will attempt to project the likely changes of electricity tariff in the event of BETs adoption.



	150 kW NI	150 kW win	100 kW NI	100 kW win	50 kW NI	50 kW win
FPC 0%	14.23	8.93	19.62	14.32	68.22	62.92
FPC 50%	18.92	13.62	26.67	21.37	93.88	88.59
FPC 75%	21.28	15.98	30.21	24.91	106.76	101.46
FPC 100%	23.63	18.33	40.6	34.25	119.64	114.34

Figure 2: Effect of feedstock price fluctuation during whole life cycle of DC system

Figure 2 reveals the typical effect of fuel price inflation on a DC system. The current WLC/kWh of generating electricity without incentive from BETs varies for DC (US$0.068-0.11) for 100kW and 150kW only, GAS (US$0.05-0.11) and AD (US$0.046 -0.13) for the capacities under study. However, in the event that the feedstocks cost changes by 50%, 75% and 100%, using 12hours supply as the base case, the WLC/kWh of generating electricity from DC will averagely increase by 35%, 52% and 87% respectively. This is similar to other systems in the same order: GAS 13%, 20% and 26%; and AD system 10%, 16% and 21%.

DISSCUSSION

The findings in respect of BETs investment cost especially for 100 kW and above astonishingly reveals that they are cost competitive with majority of recently built fossil fuel (FF) thermal plants in Nigeria representing over US$1,000/ kW despite the fact that they are large scale (many MW) capacities compared with this study's capacities not exceeding 150kW and largely emerging technologies. Hence, BETs are suitable for self-generated energy for bungalow or block of flats accommodation given the capacities evaluated in this study. Furthermore, investment costs structure findings as highlighted in table 3 agrees with IRENA (2012) that "The converter systems usually accounts for the largest share of capital costs". However, the findings disagree with Macdonald (2011) in that the percentage contribution of the generators (secondary converters) to the overall investment cost ranges between 5% - 15% as against average of 34% in this context.

The difference between this research and Macdonald (2011) is that this study focuses on small scale capacities (kW), while his study is on many MW. Hence, economies of scale have significant impact in reducing unit cost of a system. The reason for high cost structure of the conversion systems in this case, is because all the adopted systems are automatic and mobile (especially DC and GAS); with limited permanent civil structure and electrical interconnectivity and less labour utilisation during operation considering the location of usage (rural areas). The technology that has the highest cost of conversion system is the AD, while the lowest is the GAS. This finding disagrees with Evans *et al*., (2010) that "combustion based technologies are more profitable over their life cycle than gasification and pyrolysis". Also, considering all the BETs in this context, none of the scenarios exceed the current electricity tariff in the country using FF sources (US$0.13) other than for a DC system with 50kW capacity. In addition, the findings also reveal that BETs are more

economical than FF sources in Nigeria. Hence, this agrees with the study by Mahapatra and Dasappa (2012) and Garba and Kishk (2015) that BETs are cost-competitive with FF sources at present and suitable for providing sustainable electricity not only in developing countries rural areas but also urban centres accommodations without incentive. However, the findings disagree with Evans *et al*., (2010) that "biomass power production is not cost effective at present". Furthermore, the study finds that the electricity tariff of all the BETs considered will rise in the event biomass fuel prices increase between 50 and 100%. Thus, used of a FIT incentive will assist in mitigating the effect of feedstock price increase; and also, will encourage the participation of investors.

CONCLUSIONS AND THE WAY FORWARD

Energy poverty in Nigerian rural areas resulting from the high cost of gridline network and gridlines network energy loses in the country means there is the need for adoption of sustainable and decentralised ways of electricity provision. Decentralised BETs has been identified as the most suitable means of electricity provision in these communities given the biomass resources availability in relation to their low energy consumption. All the BETs capacities considered in this context are largely economical than FF and suitable for providing sustainable electricity in these communities without incentive except DC (50kW). The investment cost/kW of BETs are as follows: DC (US$ 1427 -2,247), GAS (US$ 1280 – 2489) and AD (US$ 3,529 – 6,451) systems. Also, in the event of BETs adoption and fuel prices increase by 50%, 75% and 100%, the average inflation of WLC/kWh of electricity tariff for DC will be 35%, 52% and 87% respectively.

Similarly GAS cost/kWh will increase by 13%, 20% and 26% and AD system as 10%, 16% and 21%. Hence, utilisation of a FIT incentive will assist in mitigating the effect of feedstocks price increase, and will encourage participation of investors. More so, the FIT incentive utilised in this context is just an indicative as shown in table 2, hence its utilisation should be extended to decentralised energy systems not restricted to only the grid systems. This study is also recommending that government through construction practitioners particularly in developing countries should take advantages of utilising BETs, given the considerable biomass waste generated on construction site to generate low carbon electricity for their use. Further work includes the development of a framework for sustainable electricity provision in Nigerian rural areas. This will be reported in a future paper.

REFERENCES

Bocci, E, Sisinni, M, Moneti, M, Vecchione, L, Di Carlo, A and Villarini, M (2014) State of art of small scale biomass gasification power systems: A review of the different typologies. *Energy Procedia*, **45**, 247-256.

Dasappa, S (2011) Potential of biomass energy for electricity generation in sub-Saharan Africa. *Energy for Sustainable Development*, **15**(3), 203-213.

Demirbas, M F, Balat, M and Balat, H (2009) Potential contribution of biomass to the sustainable energy development. *Energy Conversion and Management*, **50**(7), 1746-1760.

Eberhard, A and Gratwick, K N (2012) *Light Inside: The Experience of Independent Power Projects in Nigeria*. University of Cape Town: The Infrastructure Consortium for Africa.

Evans, A, Strezov, V and Evans, T J (2010) Sustainability considerations for electricity generation from biomass. *Renewable and Sustainable Energy Reviews*, **14**(5), 1419-1427.

Ganesh, A and Banerjee, R (2001) Biomass pyrolysis for power generation: A potential technology. *Renewable Energy*, **22**(1), 9-14.

Garba, A and Kishk, M (2014) Renewable energy technology means of providing sustainable electricity in Nigerian rural areas: A review. *In*: A Raiden and E Aboagye-Nimo (Eds) *Proceedings 30th Annual ARCOM Conference*, 1-3 September 2014, Portsmouth, UK. Association of Researchers in Construction Management, 143–51.

Garba, A and Kishk, M (2015) Economic assessment of biomass gasification technology in Providing Sustainable Electricity in Nigerian Rural Areas. *In*: C Gorse and M Dastbaz (Eds.) *International Sustainable Ecological Engineering Design for Society Conference (SEEDS) Conference*, 17-18 September 2015. Leeds Sustainability Institute, Leeds Beckett University: Leeds, 554-565.

Gonzáleza, A, Ribaa, J-R, Puiga, R and Navarrob, P (2015) Review of micro-and small-scale technologies to produce electricity and heat from Mediterranean forests′ wood chips. *Renewable and Sustainable Energy Reviews*, **43**, 143-155.

International Renewable Energy Agency (IRENA) (2012) Renewable energy technologies: Cost analysis series.

Lemmet, S (2009) *UNEP Buildings and Climate Change: Summary for Decision-Makers*. Available from http://www.unep.org/sbci/pdfs/SBCI-BCCSummary.pdf [Accessed 23rd February 2016]

MacDonald, M (2011), *Costs of Low-Carbon Generation Technologies*. London: Committee on Climate Change.

Mahapatra, S and Dasappa, S (2012) Rural electrification: optimising the choice between decentralised renewable energy sources and grid extension. *Energy for Sustainable Development*, **16**(2), 146-154.

Mandelli, S, Barbieri J, Mereu R and Colombo E (2016) Off-grid systems for rural electrification in developing countries: definitions, classification and a comprehensive literature review. *Renewable and Sustainable Energy Reviews*, **58**, 1621-1646.

Martinot, E (2015) *Renewables 2015 Global Status Report*. Paris: Worldwatch Institute.

Míguez, J L, Morán, J C, Granada, E and Porteiro, J (2012) Review of technology in small-scale biomass combustion systems in the European market. *Renewable and Sustainable Energy Reviews*, **16**(6), 3867-3875.

Oyedepo, S O (2012) On energy for sustainable development in Nigeria. *Renewable and Sustainable Energy Reviews*, **16**(5), 2583-2598.

UNICEF (2011) Nigeria Statics at a Glance Available from http://www.unicef.org/infobycountry/nigeria_statistics.html#119 [Accessed 17th January 2015]

Wang, L, Curtis, L W, Jones, D D and Hanna, M A (2008) Contemporary issues in thermal gasification of biomass and its application to electricity and fuel production. *Biomass and Bioenergy*, **32**(7), 573-581.

Woodward, D and Demirag, I (1989) Life cycle costing. *Career Accountant*, 22-23.

World Bank (2005) World Resource Indicators, Washington DC. Available from http://www.worldbank.org/afr/findings [Accessed 13th May 2014]

THE MANAGEMENT AND CONTROL OF ENERGY AT THE DESIGN STAGE OF BUILDINGS

Laurie Brady[1] and Rachael Hanmer-Dwight

[1] *School of Built Environment, Liverpool John Moores University, Byrom Street, Liverpool, L3 3AF, UK*

[2] *Liverpool John Moores University, 70 Mount Pleasant, Liverpool, L3 5UA, UK*

An essential element of a sustainable building is the amount of operational energy that will be needed to power the engineering services which provide buildings with safe, healthy, comfortable and secure environments. The environmental impact and financial costs associated with energy running costs are factors which are increasingly recognised for their importance. The paper considers the accuracy and usefulness of energy bench-marking and discusses its application in the management of the design of sustainable buildings. Within this context, the design of building services plant is an iterative process in which design decisions become progressively more accurate. At the stage when project objectives and sustainability aspirations are not fully defined designers may use benchmarks data for preliminary energy target setting. There are several types of bench-marking systems available for predicting building energy use. Typically, benchmarks are provided in which annual energy use is allocated in terms of annual KWh/square metre of building floor area for various building types. CIBSE has developed a Technical Manual which provides more sophisticated guidance on evaluating energy performance. This investigation used TM54 and TM46 to compare predictive energy consumption against actual energy bills for an existing large educational building in Liverpool. The research consisted of seven individual applied studies, which together produced a comparative range of estimates. Subsequent review of the work indicated some imperfections; however, the TM54 method was found to produce greater accuracy for energy consumption prediction which remains an important and necessary component of sustainable design.

Keywords: benchmarking, carbon-buzz, performance gap, TM54

INTRODUCTION

The RIBA plan of work (RIBA, 2013) sets out, in a logical sequence, the stages involved in taking a building project from an identification of the need for a building project through to its handover to the client and its operational phase. The RIBA plan is not only useful for project planning, but it also illustrates the iterative nature of project design and the interdependent nature of the relationships between the project stakeholders.

After the business case for a project has been established, the next stages involve a consideration of "sustainability aspirations" and "development of project objectives". This is where the professional team begin to transform a client's requirements into practical, achievable packages of work and where budget, quality and time constraints

[1] l.j.brady@ljmu.ac.uk

Brady, L and Hanmer-Dwight, R (2016) The Management and Control of Energy at the Design Stage of Buildings. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1171-1180.

become clearer. Developing these work packages can identify a necessity for decisions which may have both technical and financial implications. The effect of these implications may create modifications to the project brief.

Within this development phase, when both design decisions and project brief may be somewhat fluid, building services engineers may be invited to predict future energy use. This is an essential element in design management, not only because this information enables the design team to allocate the areas and volumes that will be required to install and operate engineering plant and services, but it is also an early indicator of potential building energy performance. Space planning for building services is often negotiated with other disciplines. Portman (2014) refers to this process as "a battle for distribution space". This has traditionally been the role of building services consultants.

The reliability of predictive building energy data has grown in importance, particularly since a performance gap between design and actual energy use has been recognised. Research at Plymouth University (de Wilde, 2014) considers that bridging of this performance gap is crucial "if the design and engineering stage is to provide serious input to the delivery of buildings that meet their (quantified) ambitions".

Predictive building energy data

Predicting energy consumption

Appreciating how a building will perform in energy terms can have implications for the assessment of lifecycle costs and consequent project financial viability. Estimated building energy performance will indicate subsequent financial implications, both in terms of utility costing, and service/maintenance planning. If planned financial budgets are severely limited, then predicting and minimising energy may become the driving factor in design. This can affect decisions on building orientation, types of façade and servicing strategies. If in turn the Strategic Definition of a project has included a vision on how users will engage with the building, then this vision may be compromised and require adjustment depending on whether the technical design decisions (if based on energy consumption) can support this. Additionally, where energy targets are set, it may become an index of project success or failure. In fact, studies by Sun *et al*., (2016) in the USA have recognised a "performance risk" factor which may actually constrain growth in the development of energy efficient buildings.

Assessing the energy efficiency of a building must start by quantifying the energy used by that building which can then be compared to some agreed benchmark or criteria/threshold. An energy consumption benchmark may be derived by how an organisation contextualises its energy use and energy planning. Subsequently, a benchmark may be derived from:

- forward planning for utility expenditure
- operating within a scope 1 and 2 emissions reduction framework
- performance management as prescribed under the Directive on the Energy Performance of Buildings 2002/91/EC
- performance criteria in building environmental and energy assessments

Organisations with large property portfolios may have developed statistical energy use data which can be applied to new projects. Of course this would have meant that strategic energy metering had been carried out and that management had devoted

sufficient resources so that historical data was actually recovered and catalogued. Straightforward consumption records can be useful but sophisticated energy metering can produce valuable comparative data. However, in the recent past energy costs have carried less significance for business organisations than other running expenses such as salaries and property.

In any case, ability to predict energy with historic metering information may be limited if the data has failed to capture the consumption breakdown of the separate building services. This fails to support consumption comparisons on a service by service basis, and thus may risk the reliability of subsequent predictions. In this event, benchmarking tools still represent a valid process for predicting energy consumption of proposed building services.

Predicting building energy use and target-setting for the many organisations without their own statistical data is carried out by accessing published bench-mark information, energy modelling using software, or a combination of both.

Benchmarks

There are many energy assessment schemes available. Various countries have produced their own schemes. Wang (2012) categorized them under the following headings based on their target applications:

- Environmental Assessment Schemes
- Building Energy Certification
- Whole-Building Benchmarking Tools
- Hierarchical Assessment and Diagnosis tools

The UK environmental assessment scheme (BREEAM) sets criteria for energy which is related to the calculations set out in Part L of the UK Building Regulations. Important as this process is, these calculations are designed to demonstrate compliance with legislation and are not intended to be predictions of energy use (Cheshire, 2015).

The Chartered Institute of Building Services Engineers publish energy bench-mark information in two documents: “Energy Benchmarks, TM46” (Field, 2008), and “Energy Efficiency in Buildings, CIBSE Guide F”. TM46 describes the building energy benchmarks which are used in association with Display Energy Certificates. The TM46 tool is used to quantify estimated usage in a building and thus provide a ‘typical’ energy consumption benchmark. This can be compared with the building’s actual metered energy use. This comparison of energy performance is shown on the Display Certificate on a colour coded rating scale, its purpose being to raise public awareness of energy use in building.

Although, TM46 benchmarks are commonly used for predictive purposes, Display Energy Certificate data should be determined using approved software by registered consultants (Chadderton, 2013). TM46 sets out annual energy benchmarks in term of KWh/m2 (kg of CO2 emissions/m2) of floor area. Benchmarks are included for 29 types of building and TM46 includes correction factors for occupancy and weather, as well as a method for separating out high energy using processes which would otherwise undermine a typical comparison.

Guide F provides benchmark data in a similar format to TM46. Guide F differs from TM46 in that some greater detail is provided such as differentiating between “typical” and “good practice” values. The Green Building Council (2013) expressed a concern

regarding the age of Guide F data and noted that some of the benchmarks had been updated through TM46. In the same document by the Green Building Council it was noted that "CIBSE Guide TM54 is intended to form the missing link between design stage estimates."

Carbon Buzz

Carbon Buzz (CIBSE, 2016) is a database platform which has been set up in a joint venture by RIBA and CIBSE in response to a realization that many buildings use more energy than was predicted at design stage. This phenomenon is termed the "Performance Gap" and this quantifies the amount of actual energy use by a building in comparison to its design figure. The Carbon Buzz website states that "on average buildings consume between 1.5 and 2.5 times predicted values".

Carbon Buzz is a freely accessible site in which participants can enter building energy case studies or simply browse. Case studies may be anonymous. The available data enables users to compare their own building energy performance against similar categories.

Dynamic simulation modelling

The energy used in buildings is influenced by the dynamic nature of the effects of convection, conduction, radiation between building fabrics, furniture, occupants and equipment, as well as by constantly changing weather conditions. In the past this level of interaction has been reduced to steady state, or semi-transient calculations for design calculations which, though simplified, could still require many long-winded calculations where loadings and plant sizing were based on worst case scenarios. Heating plant was sized for the lowest winter temperature and cooling plant for the highest summer gain.

The power of software has led to the development of computer models which can cope with sophisticated heat transfer and storage calculations which would have been impossible to complete by hand and should therefore produce more accurate results, if provided with reliable input data. Some of the major modelling packages available include: Energy Plus, TAS Building Designer and IES. The characteristics of these systems (Jankovic, 2012) tend to hinge on the how users interface with the software and the ease with which simulations can be run. Though the mathematical power available has proved to be invaluable, it has become apparent that some software systems do not account for actual operating circumstances.

TM54 and the performance gap

TM54

One of the responses to the Performance Gap question has been the publication of CIBSE Technical Manual TM54, "Evaluating operational energy performance of buildings at the design stage" (Cheshire, 2013). One of the aims of this document is "to provide a methodology that engineers can use to undertake better-informed calculations of energy use in operation".

The two main causes for the performance gap cited in TM54 are that design calculations do not account for all building energy uses, and that site practice does not always result in designs being built as intended. In the context of site practice Davies includes commissioning and operation of buildings. Site practice is outside the scope of TM54.

The methodology employed by TM54 recognises some of the "inherent simplifications" contained in dynamic simulation software and therefore also includes some long-hand calculations. Figure 1 (below) summarises the TM54 methodology.

Comparing TM46 and TM54 estimates with energy bills for an existing building
An exercise in the application of TM54 and TM46 energy assessment methods was carried out for an educational building in Liverpool with the aim to examine the value of CIBSE-developed energy prediction tools. The purpose of comparing the outcome of both tools was twofold. First, while TM54 is a newer tool, both enjoy prevalent use in the construction industry and are therefore both relevant to an exploration of how well they serve energy prediction purposes. Second, any comparable differences between the TM46 and TM54 studies could demonstrate what degree of progress has been made in predicting energy more accurately and in reducing the performance gap, as per the rationale behind development of TM54. A group of seven building service engineers each prepared energy estimates for the project. The group included mechanical and electrical engineers from a mixture of consultancy or contractor backgrounds. Each engineer had professional occupational responsibilities of at least an intermediate level but had not previously used either of these systems.

University Estates managers provided record drawings and arranged for site surveys, though these were mainly basic visual inspections.

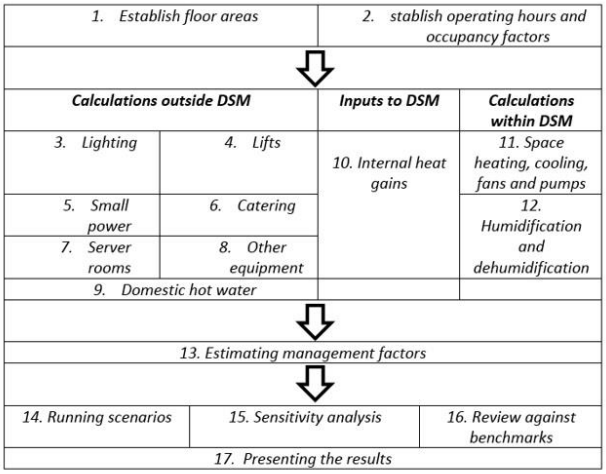


Figure 1: TM54 methodology

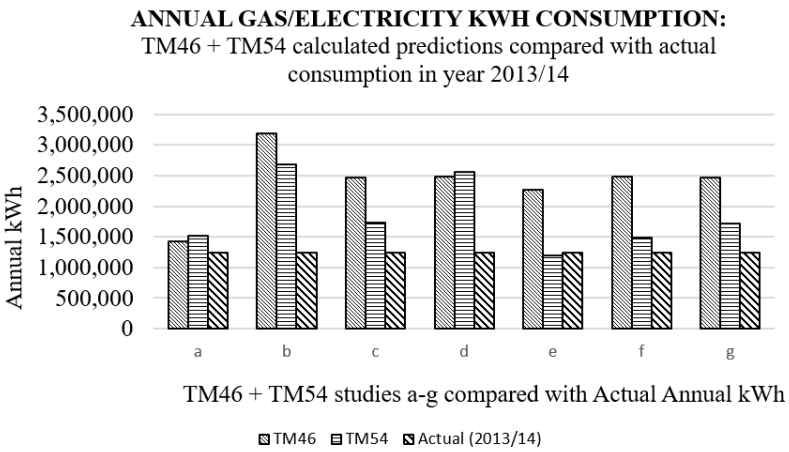


Figure 2: TM54, TM46 and annual energy use

Between the predictive studies (see Figure 2 above) TM46 and TM54, the overall percentage differences between each study and the actual consumption show that TM54 was more reliable in its predictions. Whilst both over-estimated, the median percentage difference between TM54 and actual consumption was +38%, whilst the respective median percentage difference between TM46 and actual consumption was considerably greater at +99%.

Additionally, if those studies which give rise to a prediction in excess of 200% of the actual consumption are removed (if treated as anomalies), this strengthens the reliability of TM54 over TM46 further still: TM46 median actually remains as +99%, whilst the TM54 median reduces from +38% to +22%. Both indicate a consistent over-estimation, but TM54 is nonetheless producing a more accurate prediction than TM46.

When observing the breakdown within the TM54 studies, the tool appears to work better for some services over others (see Table 1). 'Dehumidifying' calculations represented the tightest figures across the seven studies; conversely, 'Lighting' and 'Server Room' calculations encountered the greatest variation of the specified services. 'Other' services calculations represented the largest variance of all and highlights a potential challenge in the use of energy prediction models:

Table 1: Variance in the TM54 studies' predictions, by building service

Building Service	Coefficient of variance (%)
Dehumidifying	12
Domestic hot water	20
Space heating	21
Lifts	22
Small power	34
Server rooms	46
Lighting	58
Other	125

All estimates (TM46 and TM54) predict higher than actual energy use. The average TM46 estimate was almost double the actual energy use (193%), whilst the average TM54 figure was 1.48 times the actual energy use value. Though there are discrepancies between actual and predicted energy use, the exercise simulated a typical early design stage situation in which not all decisions have been finalized, and therefore it would be expected that figures would be approximate. The access and data given to the engineers carrying out this work was limited. This was due partly to the workload of facilities managers whose priorities are arranged around operational matters, and also the time pressures on the engineers preparing the estimates. All factors which would be familiar to working engineers and managers.

That TM54 energy predictions were all high in this case, would infer that accuracy can be improved by familiarity with the technique and a more intimate knowledge of building occupancy and operation. The process is straightforward and logical, particularly when compared with other prediction models, many of which rely completely on software with varying levels of complexity. An example of this approach is demonstrated by Brohus *et al*., (2012).

Since the level of accuracy for TM54 is linked to knowledge of building use, approximate predictions must be expected and will need to be fine-tuned as information is firmed. Improved support for designers during the design process is welcomed to ensure that the best decisions can be made with regards building services; however, it is worthwhile considering that the areas of variance are typically those which experience a greater user engagement and, thereby, energy impact. Increased awareness of this may encourage greater support not only for the design process but also for the user interface and engagement upon occupancy. The decision in the early design stages to employ a tool like BSRIA's Soft Landings may lend itself to better-manage the behaviour element of building energy control. This may improve accuracy of prospective energy predictions.

The validity and role of energy prediction techniques for the management of construction projects

How worthwhile is the process of predicting energy use? Using a cost control analogy, it is normal practice for quantity surveyors to commence with approximate estimates which are refined as project information is firmed. The availability of pricing data used by quantity surveyors has been available for long enough for it to become sophisticated. For example, on-line cost data is regularly updated and characterised to reflect such elements as location, construction type, market conditions, and more. This is not quite yet the case for building energy data, though initiatives like Carbon Buzz are compiling actual energy-use data. Research by Robinson and Mumovic (2014) found that although many consultants often collect information about their buildings, fear of liability restricted wider access.

A recent research exercise by Innovate UK (Palmer *et al*., 2016) looked at 50 "leading edge" buildings and found that the average carbon emission rate was 3.8 times higher than that used to show compliance with building regulations; a figure greater than the multiplier quoted by Carbon Buzz. Although the predicted loads which fall under UK building regulations compliance do not account for unregulated loads*, the report does consider that meeting UK carbon reduction targets will be "an unattainable goal, unless there is a revolution in how the country constructs and operates buildings".

Evidence suggests that buildings use too much energy post-occupancy. This is dramatically demonstrated if compared to predicted energy use, yet energy benchmarks can vary. Although building services are the largest energy users in building lifecycle terms (Churcher, 2013), building services designers specify systems and plant in response to the loads imposed on a building. Those building loads result from the way architects and other construction professional meet client requirements. If this process is considered in reverse, then much of a building's energy load can be reduced by intelligent architectural and structural design. In other words, the key to achieving a low energy building is a combination of active and passive design. This idea is not new and can be recognised in slogans such as "fabric first" or in the carbon hierarchy concept, however it does suggest that its application requires a multi-disciplinary management approach.

From a practical standpoint, the usefulness of energy predictions include:

- Contributions to initial assessment of project viability

* UK Building Regulation (Part L) calculations refer to regulated loads only. Unregulated loads include small power or "plug loads", lifts etc.

- Early feasibility assessments of the effects of building orientation
- Feasibility guidance on project servicing strategy
- Determination of plant spaces and volume requirements

Whilst these inputs are valid, project managers must recognise the implications for collaborative management strategies (Pittard and Sell, 2016). An awareness of the "chicken and egg" nature of building design is vital.

It is difficult to reconcile actual and estimated values against the various headings in TM54 because meters often record gas or electricity use for whole buildings. It should be noted that Part L of the building regulations now calls for more strategic metering arrangements. However, there are some factors which can be considered to be significant:

- Dynamic Simulation Modelling – software systems can be complicated with large learning curves
- Surveys – although access to the building was available for examination of plant and systems, information on occupancy and operational matters was sparse
- University facilities managers' major role is to maintain buildings at a safe and operational level, leaving little time for deep examination of system performance

This particular university building includes laboratories, postgraduate research offices, educational administrative offices as well as teaching spaces. This combination of room usage demands lower student occupancies

CONCLUSIONS

This paper suggests that the process of predicting building energy use contributes to several construction management functions. In terms of design management, predicting energy use is an iterative process in which accuracy is increased as design moves from concept to developed design. To be successful this process should inter-relate and develop in step with the other design disciplines. An appreciation of the energy implications of architectural and structural design decisions can improve overall building design. However, this will only be practical if each party accepts the sketch-type nature of early proposals. Reviewing and re-working ideas may increase workloads and this may need to be reflected in fees.

Predicting energy use enables designers to allocate space for plant. Research by Wan and Kumaraswamy (2012) concluded that poor co-ordination in building services projects is a "critical production shortcoming", and that the process of space conflict resolution during installations may result in demolition, replacement or rework. BIM is seen as offering a solution to co-ordination issues. However, Godden and Mansell-Thomas (2016) provide a reality check in their examination of digital techniques for construction. Their work identifies that, presently, major disconnect exists between the "shared data environment" of designers and site reliance on "red pens and photocopiers".

Though accurate sizing and co-ordination are vital components of low energy design, early energy predictions also enable construction managers to take the first steps in tackling performance gaps and developing a project energy control plan. This paper compares the concept of energy control plans with cost control plans. Quantity

surveyors are now embracing the idea of in-use costs. Operational energy represents the greatest portion of life-cycle energy costs.

Managing the energy the use of buildings has been likened to cost management. The sophistication of the data available to quantity surveyors has been recognised. In comparison, the energy prediction exercise described in this paper identifies some imperfections in the use of energy benchmark data. All of the predictions exceeded actual energy use and, within this, small power and lighting resulted in the most generous estimates. Estimates of occupancy and user behaviour are major causes of approximation error for both longhand and dynamic simulation elements of predictions. This may be partly resolved when accurate details of occupancy numbers and periods become clear, though lack of clarity can typify early sketch scheme situations. The TM54 methodology recommends sensitive analysis of results.

Another contributor to approximation error is proficiency in the application of dynamic simulation software. All of the estimators who carried out the energy predictions are working engineers and are competent software users. However, dynamic simulation packages can require specialist training and often require to be accessed frequently in order for users to maintain competence levels, particularly as these systems are regularly updated. This has management implications for construction organisations in which it may be necessary to find the right blend of computer-literate graduates and experienced professionals.

Clearly, though energy consumption predictions at the building design stage will often include approximations, the exercise is nonetheless a critical element in sustainable design and will improve as the quality and management of feedback data research gains in its sophistication.

REFERENCES

Brohus, H, Frier, C, Heiselberg, P and Haghighat, F (2012) Quantification of uncertainty in predicting building energy consumption: A stochastic approach. *Energy and Buildings*, **55**, 127-140.

Chadderton, D (2013) *Building Services Engineering*. Abingdon, Oxon: Routledge.

Cheshire, D (2015) The problems with design stage estimates of energy use of buildings and how this can be improved by using the methodology set out in CIBSE TM54. *Journal of Building Survey, Appraisal & Valuation*, **4**(2), 150.

Cheshire, D and Menezes, A C (2013) *Evaluating operational energy performance of buildings at design stage TM 54*, CIBSE. Suffolk: Lavenham Press.

Churcher, D (2013) *Life Cycle Assessment: An introduction*. Bracknell, BSRIA.

De Wilde, P (2014) The Gap between predicted and measured energy performance of buildings: A framework for investigation. *Automation in Construction*, **41**, 40-49.

Field, J E A (2008) *CIBSE TM 46 Energy Benchmarks*. London: CIBSE.

Godden, E and Thomas, L M.- (2016) *Digital Masterbuilders: Modernising Communication Between Designers And Constructors*. CIBSE Technical Symposium, Heriot-Watt University Edinburgh, 14-15 April 2016. Edinburgh: CIBSE.

Palmer, J, Terry, N and Armitage, P (2106) *Building Performance Evaluation Programme: Findings from Non-Domestic Projects*. Available from https://connect.innovateuk.org/home [Accessed 9th March 2016].

Pittard, S and Sell, P (2016) *BIM and Quantity Surveying*. Abingdon, Oxon: Routledge.

Portman, J (2014) *Building Services Design Management*. Oxford, John Wiley and Sons.

RIBA (2013) *RIBA Plan of Work, 2013*. London: Royal Institute of British Architects. Available from http://www.ribaplanofwork.com/ [Accessed 15th February 2016]

Roberston, C and Mumovic, D (2014) Building performance in the context of industry pressures. *International Journal of Energy Sector Management*, 8(4), 527-543.

Sun, S, Kensek, K, Noble, D and Schiler, M (2016) A method of probabilistic risk assessment for energy performance and cost using building energy simulation. *Energy and Buildings*, **110**(1), 1-12.

Wan, S K M and Kumaraswamy, M M (2012) Improving building services coordination at the pre-installation stage. *Engineering, Construction and Architectural Management*, **19**(3), 235-252.

Wang, S, Yan, C and Xiao, F 2012 Quantitative energy performance assessment methods for existing buildings. *Energy and Buildings*, **55**, 873-888.

Wright, B, Lillicrap, C, Cheshire, D, Treanor, J, Lindey, M, Cotton, M, Mcdonald, N, Lynes, P and Jones, P (2013) *CIBSE Guide F*. UK: Green Building Council. Available from http://www.ukgbc.org/resources/additional/pinpointing-discussion-cibse-guide-f.

ENHANCEMENT OF GREENNESS OF NEW CONSTRUCTION USING THE DEA

Gayatri Sachin Vyas[1], Kumar Neeraj Jha[2] and Dilipkumar Arvindkumar Patel[3]

[1&2] *Department of Civil Engineering, Indian Institute of Technology Delhi, Hauz Khas, New Delhi 110016, India.*

[3] *Civil Engineering Department, Sardar Vallabh National Institute of Technology Surat, Ichchhanath, Dumas Road, Surat-395007 (Gujarat), India.*

In India, the construction industry is the second largest after agriculture, accounting for roughly 5-6% of the gross domestic product. Therefore, sustainable construction plays an effective role to maintain a sustainable environment. Green building rating system provides a functional framework for evaluating building environmental performance and incorporating sustainable development into building and construction processes. It is used as a design tool by setting sustainable design priorities and goals, developing appropriate sustainable design strategies; and determining performance measures to guide the sustainable design and decision-making processes. To achieve sustainable development, higher attention has been paid to economic and environmental impacts associated with construction and operation of structures. Hence, prominence towards a more sustainable approach to green building design and cost effectiveness has gained momentum. In this research Indian green building assessment tools such as GRIHA, IGBC, and eco-housing are studied. The data envelopment analysis (DEA) assesses the relative efficiency of green building attributes relative to the rest of the green attributes in terms of cost. The main aim of this study is to maximize greenness of new construction in the limited fund by applying the data envelopment analysis (DEA). It is observed that the attributes: energy performance, utilization of fly ash, and use of regional materials are giving more green points at lesser cost. Findings of this paper can be helpful to green building planners, designers and developers.

Keywords: green building, AHP, sustainable buildings, rating systems, DEA

INTRODUCTION

As more and more construction activities are taking place it exerts huge environmental impacts. So there is a need to adopt a sustainable construction without spending a large cost (CCI, 2015). Sustainable construction is defined by Pearce and Turner (1990) as maximising the net benefits of economic development, subject to maintaining the services and quality of natural resources over time. Green building is the revolutionary development practice centred upon the mission of creating buildings which apply an increased efficiency of resources such as energy, water, and materials. In turn, green building reduces building impacts on human health and the environment by implementing improved site location, design, construction, operation, maintenance, and removal encompassing the complete life cycle of the building because they are using the recycled materials and using materials that are eco-friendly throughout

[1] gayatrivyasphd@gmail.com

Vyas, G S, Jha, K N and Patel, D A (2016) Enhancement of Greenness of New Construction Using the DEA. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1181-1189.

(Vyas *et al*., 2012; Vyas and Jha, 2016). Practitioners of the green building often seek to achieve not only ecological but aesthetic harmony between a structure and its surrounding natural and built environment, although the appearance and style of sustainable buildings are not necessarily distinguishable from their sustainable counterparts. The built environment has a profound impact on our natural environment, economy, health and productivity. Breakthroughs in building science, technology, and operations are now available to designers, builders, operators and owners who want to build green and maximize both economic and environmental performance (Bartlett and Howard, 2000). Green buildings are energy efficient, water conserving, durable and non-toxic, with high-quality spaces and high-recycled content materials (Vyas *et al*., 2012; Vyas and Jha, 2016).

Several researchers (Ries *et al*., 2006; Agrawal and Tiwari, 2010; Cabeza *et al*., 2014) attempted to calculate the life cycle cost of a green building or green building components but it fails to find out and recommend where to invest. Therefore, there is a need to develop a cost model which increases green points in less cost. Thus the objectives of the study are: (1) to study different green building rating systems in India, and (2) to develop cost investment options for green building developers to achieve more green points in the available fund. For the second objective, the application of the Data Envelopment Analysis (DEA) is proposed. This is a linear programming-based technique for measuring the performance efficiency of organisational units which are termed Decision-Making Units (DMUs). This technique aims to measure how efficiently a DMU uses the resources available to generate a set of outputs (Charnes *et al*., 1978). The DEA has following advantages: (1) It allows effective use of multiple inputs and multiple outputs (Ramanathan, 2003), (2) The weights of inputs and outputs are not needed by decision makers, (3) each DMU efficiency is compared to that of the best operating unit, rather than to the average performance. On the other hand, the main limitation of the DEA is that standard formulation of DEA creates a separate linear program for each DMU. This will be computationally exhaustive when the number of DMUs is large (Raju and Kumar, 2006).

The remainder of this paper is organized as follows. First, the Indian green building rating systems are described. Second, the DEA technique is explained. Third, EMS software is applied for green building attributes. Finally, the results obtained are discussed.

CONCEPT OF GREEN BUILDINGS IN INDIA

The Leadership in Energy and Environmental Design (LEED) India green building rating system was developed by the Indian Green Building Council (IGBC) in October 2006. In 2015, the IGBC separately developed an IGBC green new building rating system. The categories and weights adopted in this rating system are: sustainable architecture and design-5%, site selection and planning- 14%, water conservation-18%, energy efficiency-28%, building materials and resources-16%, indoor environmental quality-12% and innovation development. The IGBC assessment tool is developed for new construction, existing buildings, commercial interiors, core and shell, homes, neighbourhood development, school, and retail. This system awards a rating of buildings as certified, silver, gold, platinum and super platinum. It uses simple checklist format to rate building performance (IGBC rating, 2015).

Green Rating for Integrated Habitat Assessment (GRIHA) is the Indian national green building rating system. It was developed by The Energy and Resources Institute

(TERI) in 2007. Recently, the GRIHA version 2015 is applied in Indian construction. The categories and weights adopted in this rating system are: sustainable site planning-8%, occupant comfort and wellbeing- 12%, sustainable building material-14%, energy -20%, water-17%, construction management - 9%, solid waste management-6%, socio economic strategies - 6%, and performance monitoring and validation -8%. The GRIHA rates the buildings one star if the score is from 25-40, two stars for scores 41-55, three stars for scores 56-70, four stars for scores 71-85, and five stars for scores above 86 % (GRIHA rating, 2015).

The eco-housing assessment tool was developed in 2006 for Pune City only. In 2009, Version II was introduced, and it is used in Pune and to some extent in Mumbai also. In Pune, it is popular in small to medium residential projects. The categories and weights adopted in this rating system are: site planning-14%, environmental architecture - 8%, efficient building material-19%, energy conservation -24%, water conservation-15%, solid waste management- 12%, and other innovative measures -8% (Vyas and Jha, 2016).

A green building may cost more upfront but saves through lower operating costs over the life of the building. The green building approach applies a project life cycle cost analysis for determining the appropriate upfront expenditure. Some benefits, such as improving occupant health, comfort, productivity, reducing pollution and landfill waste are not easily quantified. Fund allocation in the budget is essential to accommodate the cost for research and analysis of investment in green building attributes. Even with a tight budget, many green building measures can be incorporated with minimal or zero increased upfront costs and they can yield enormous savings (Environmental Building News, 2015).

DATA ENVELOPMENT ANALYSIS (DEA) METHODOLOGY

The DEA is used for measurement of efficiency amongst the data available. The DEA is a nonparametric method of measuring the efficiency of decision making units (DMU's) (Ray, 2004). In the DEA, efficiency is defined as a weighted sum of outputs to a weighted sum of inputs. The DEA only gives relative efficiencies - efficiencies relative to the data considered. Efficient frontier encompasses the given input and output data. An efficiency measure quantifies in one way or another the distance to the efficient frontier. All efficiencies are restricted to lie between zero and one (i.e. between 0% and 100%). In calculating the numerical value of the efficiency of a particular DMU, weights are chosen so as to maximize its efficiency, thereby presenting the DMU in the best possible light. El-Mashaleh *et al*., (2010) carried out the DEA to benchmark safety performance of construction contractors. Vinter *et al*., (2006) constrained the DEA evaluation by the sum of number of inputs and outputs versus the number of DMUs. They considered inputs as cost work content, the level of monitoring, level of uncertainty, DMU as various type of projects (11 numbers), and output as design yield, operational yield, training yield, dimensional yield, project management yield, Schedule Performance Index (SPI), and Cost Performance Index (CPI). Several researchers presented techniques to reduce inputs and outputs and make it suitable to apply the DEA to study the project efficiency even though having multi project environment. Wakchaure and Jha (2011) presented a method using the DEA which is useful to allocate fund for repair and maintenance of existing bridges based on several factors rather than only on bridge condition. According to Ozbek *et al*. (2010), DEA models can be mainly classified into the model experiencing constant returns to scale- Charnes-Cooper- Rhodes formulation (CCR) or the model

experiencing variable returns to scale -Banker-Charnes-Cooper formulation (BCC) (Charnes, 1978).

Generally, the following steps are used to apply the DEA and to determine the efficiency score.

11. Deciding the decision making units (DMU's)
12. Selecting input/output variables for the DEA and running the DEA model
13. Selecting an appropriate DEA model
14. Running the DEA model and determining efficiency scores for factors.

The CCR model assumes that measured efficiency is directly proportional to the inputs and output and it does not consider the effect of external factors. As in the present study cost and selected green building attributes play very important role, the CCR model is selected for analysis.

Charnes-Cooper-Rhodes (CCR) DEA model

This research makes use of the CCR model of the DEA to find out prominent green building cost attributes. The mathematical form of the CCR model is given in Eqs. 1, 2, 3, and 4 (Cooper *et al*., 2000). The objective function is to maximise the efficiency of DMU.

Maximise

$$Z_o = \sum_{r=1}^{s} u_r y_{r0} \quad (1), \quad subject\ to \sum_{i=1}^{m} v_i x_{i0} = 1 \quad (2), \quad \sum_{r=1}^{m} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \leq 1 \quad (3),$$

i = 1,……m, j= 1,….,n , r=1,……, s and u_r , $v_i \geq 0$. (4)

Where,

Z_0: the measure of efficiency for DMU_0 (the DMU under evaluation), which is a member of the set j = 1, . . ., n DMUs.

u_r: the output weight. It is determined by the solution of the model and is assigned to the observed r^{th} output.

v_i: the input weight. It is determined by the solution of the model and is assigned to the observed i^{th} input.

y_{r0}: the known amount of the rth output produced by DMU_0.

x_{i0}: the known amount of the ith input used by DMU_0.

y_{rj}: the known amount of the rth output produced by DMU_j.

x_{ij}: the known amount of the ith input used by DMU_j.

The CCR model of the DEA is used to identify green building attributes. The model yields efficiency scores between 0 and 1. A green building attribute can be used if its efficiency score is 1. This means that one can invest in the respective green attribute which has less cost and greener points. Fig. 1 shows the related inputs and output.

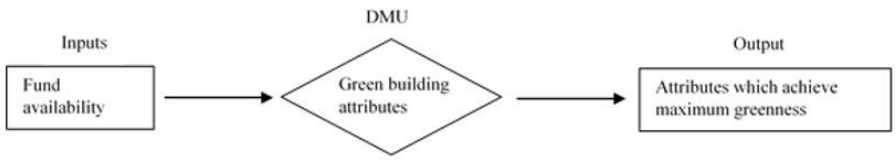


Figure 1 Inputs and output of green building parameters

Application of DEA in present study:
In the present study, an existing Indian green building is considered which is rated by the GRIHA and assigned five star rating and the IGBC which has rated it as platinum. The bill of quantity of each of selected buildings is collected.

Selection of variables for the DEA
For the selection of decision making units, the main criterion is limited fund. The factors that are selected are shown in Table 1. The reasons for the inclusion of the factors and other factors affecting the greenness are also provided in Table 1. The variables decided to be used in the DEA are: (i) cost involved in each factor, (ii) area of the site, (iii) maintenance cost of each factor.

Table 1: List of variables used in the DEA

S. No.	The possible variables	Whether considered for DEA analysis	Remarks/ reasons for exclusion
1.	Energy performance	Yes	If we invest in this, the possible points obtained can easily be increased.
2.	Water use reduction	Yes	The amount required is less and most of the cost is included in the pre requisite.
3.	Storm water usage	Yes	For efficient water use.
4.	Water efficient landscaping	Yes	The amount required is less and most of the cost is included in the pre requisite.
5.	Thermal comfort	Yes	It can be done during the design stage which includes less cost.
6.	Light sensors	Yes	It is related to the energy performance factor.
7.	Increased ventilation	Yes	It is done in the design phase with which more sun light is allowed,
8.	Low VOC paints	Yes	In this, the cost involved is less and the health of the occupant is related to this.
9.	Use of regional materials	Yes	This helps in cutting down the building materials cost.
10.	Utilization of fly ash	Yes	This helps in saving money during the construction of walls.
11.	Rapidly renewable materials	Yes	These are eco-friendly materials and very cost effective.
12.	Alternative transportation	No	It depends on the locality of the site.
13.	Green power	No	This is not possible when we consider limited funds.
14.	Outdoor air delivery management	No	It involves more cost.
15.	Brown field redevelopment	No	We are considering limited funds.

The DEA model selection
After selection of the input/output variables, it is necessary to determine the returns to scale experienced by the DMUs under investigation. In this study, the model CCR is applied as it considers constant returns to scale, and the output increases by the same proportional change of each proportional increase in the input (Ramanathan, 2003).

Efficiency Measurement System (EMS)
Efficiency Measurement System (EMS) is a software which computes the DEA efficiency measures. The EMS is used for the determination of efficiency scores of

the greenness factors. The output of the DEA model includes efficiency scores and benchmarks (Scheel, 2000).

Preparing the input and output data

The first and probably the most difficult step in an efficiency evaluation is to decide which input and output data should be included. The EMS accepts data in the MS Excel or in text format (Scheel, 2000). The prepared data sheet is shown in Table 2.

Table 2: Input, DMU and output data of considered green building

S. No.	DMU	Cost (INR)(I/P)	Area (sqm) (I/P)	Maintenance cost (INR)(I/P)	Change in greenness points (O/P)
1.	Energy performance	20,000	1500	5,000	13
2.	Water use reduction	30,000	1500	1,000	4
3.	Storm water usage	30,000	1500	1,000	2
4.	Water efficient landscaping	10,000	1500	1,000	4
5.	Thermal comfort	10,000	1500	500	2
6.	Light sensors	12,000	1500	1,000	1
7.	Increased ventilation	5,000	1500	500	1
8.	Low VOC paints	20,000	1500	5,000	2
9.	Use of regional materials	-5,000	1500	1,000	2
10.	Utilization of fly ash	-10,000	1500	2,000	2
11.	Rapidly renewable materials	20,000	1500	3,000	1

Table 3 shows the result of the DEA model obtained by the EMS 1.3 software.

Table 3: Results of the DEA model

S.No	DMU (2)	Efficiency score (3)	Ranking based on efficiency score (4)	Benchmarks (5)
1.	Energy performance	325.00%	1	2
2.	Water use reduction	100.00%	5	4
3.	Storm water usage	50.00%	7	2 (0.20), 4 (0.30)
4.	Water efficient landscaping	127.47%	4	6
5.	Thermal comfort	100.00%	6	2 (0.08), 4 (0.42)
6.	Light sensors	25.00%	9	2 (0.01), 4 (0.24)
7.	Increased ventilation	50.00%	8	4 (0.25)
8.	Low VOC paints	15.38%	10	1 (0.15)
9.	Use of regional materials	200.00%	3	0
10.	Utilization of fly ash	200.00%	2	0
11.	Rapidly renewable materials	11.76%	11	1 (0.06), 2 (0.01), 4 (0.05)

The output of the DEA model includes efficiency scores and benchmarks. These are shown in the columns 3 and 5 of Table 3. The attribute scores 100% and above are termed ‘efficient’ factors and the remaining as ‘inefficient’. The efficiency scores have been used for ranking the green building cost attributes (Scheel, 2000). The attributes with the maximum efficiency score are given the maximum priority. The ranks are established on the basis of efficiency scores in columns 3 of Table 3.

Out of the 11 attributes, 1) energy performance 2) water use reduction, 3) water efficient landscaping, 4) thermal comfort 5) use of regional materials and 6) utilization

of fly ash are found to be efficient while the remaining attributes are found to be inefficient.

The DEA gives the relative efficiency, i.e. the ratio of weighted output to the weighted input. It is necessary to assign weights to input and output variables. These weights are chosen and optimized by the DEA program so as to provide an equal chance to every input and output variable (Scheel, 2000; Ramanathan, 2003). The main application of DEA for the current study is its ability to handle multiple inputs and multiple outputs. To achieve more green points in limited fund, DEA prioritise multiple options of green attributes based on its initial cost, O&M cost and area. In the current study, most referenced factors (DMUs) are the efficient attributes (with an efficiency score of 100), the values of which are used to determine and optimize the weights by the inefficient attributes. The relative weights are also given for the referenced attributes. Benchmarks (column 5 of Table 3) are the output of the DEA analysis. Benchmarks for inefficient (DMU) attributes indicate the referenced attributes (DMUs) with corresponding intensities (weights) in brackets (see column 5 of Table 3). For example, the attribute 'storm water usage' is an inefficient attribute, having a score of 50. This attribute (DMU) has two efficient attributes: 'water use reduction' and 'water efficient landscaping', as benchmarks with intensities (weights) of 0.20 and 0.30 respectively. This has been shown as 2 (0.20) 4 (0.30) in column 5of Table 3.

Benchmarks from Table 3 indicate the number of the inefficient attributes (DMUs) which have been chosen on the basis of the efficient green building cost. The efficient attributes should be selected first for the investment of cost in green building as they can increase greenness in an available cost. The most referenced attributes (DMUs) are energy performance, water use reduction, water efficient landscaping, and thermal comfort, use of regional materials and utilization of fly-ash.

DISCUSSION

The Indian construction industry currently lacks any readily available cost model of green buildings for the selection of attributes in limited funds. To judge investment model, the industry currently relies on the segregated and a large number of reports of the different types of green building attributes (Johannes, 2015). As such, the DEA approach is well suited to fill this gap and to assess where to invest. The DEA approach presented in this paper can be utilized by a particular green building developer to achieve more green ratings in a limited fund. Additionally, the proposed methodology is deployable at the project level. Every project has multiple DMUs of green building attributes. DMUs are ''benchmarked" against each other in DEA. Consequently, developer will be able to identify their best performing green building cost attributes.

CONCLUSIONS

The data envelopment analysis helps in finding the efficiency of the factors which are selected based on the cost factor. The model selected for this project is the CCR model. In this model output increases by the same proportional change of each proportional increase in the input. The EMS 1.3 software has been used for the DEA to find out the efficiencies of the attributes. Energy performance is found as the most efficient attribute with an efficiency score of 325%.

Based on this study, following attributes are required to be considered while constructing green buildings: 1. Energy performance, 2. Utilization of fly ash, 3. Use

of regional materials, 4. Water efficient landscaping, 5. Thermal comfort, 6. Water use reduction. When a building satisfies all the pre requisites of the IGBC then they should consider these attributes to get more green points and thus get a green rated building. All the factors proposed here are very economical when compared to the other parameters. The limitation of the current study is that developed cost model includes only one case study in Indian context only. This study can be applied to green buildings in other developing counties.

Even though the cost model in this paper is based on data collected from the Indian construction industry, the methodology would suggest a much broader geographical applicability on cost model for green construction projects internationally. The next step for the research team is to develop a cost model for a number of case studies from different geographical and climatic region.

REFERENCES

Agrawal, B and Tiwari, N (2010) Life cycle cost assessment of building integrated photovoltaic thermal (BIPVT) systems. *Energy and Buildings*, **42**(9), 1472–1481.

Bartlett, E and Howard, N (2000) Informing the decision makers on the cost and value of green building. *Building Research and Information*, **28**(5-6), 315-324.

Cabeza, F, Rincón, L, Vilariño, V, Pérez, G and Castell, A (2014) Life cycle assessment (LCA) and life cycle energy analysis (LCEA) of building sand the building sector: A review. *Renewable and Sustainable Energy Reviews*, **29**(Issue C), 394-416.

Charnes, A, Cooper, W and Rhodes, E (1978) Measuring the efficiency of decision making units. *European Journal of Operational Research*, **2**(6), 429-444.

Cooper, W, Seiford, L and Tone, K (2000) *Data Envelopment Analysis: A Comprehensive Text with Models, Applications, References and DEA-Solver Software*. New York: Kluwer Academic Publishers.

Corporate Catalyst India (2015) *CCI*. Viewed 12 January 2015, http://www.cci.in/pdfs/surveys-reports/real-estate-sector-in-india.pdf

Eco-housing rating system India viewed on 1 January 2016, www.mcgm.gov.in/irj/portalapps/com.mcgm.ecohousing/docs/Eco_housing_Construction.pdf.

El-Mashaleh, S, Rababeh, M, and Hyari, H (2010) Utilizing data envelopment analysis to benchmark safety performance of construction contractors. *International Journal of Project Management*, **28**(1), 61-67.

Environmental Building News (2015) *Green Rating for Integrated Habitat Assessment 2015*. GRIHA, India, viewed on 21 June 2015, http:// www.grihaindia.org.

IGBC Green New Buildings (2015) *India*, viewed on 1 January 2016 https://igbc.in/igbc/redirectHtml.htm?redVal=showGreenNewBuildingsnosign.

Johannes, A, Anders, C and Zia, H (2015) *Energy-Efficient Buildings: A Business Case for India? An Analysis of Incremental Costs for Four Building Projects of the Energy-Efficient Homes Programme*. Berlin/New Delhi: Adelphi/TERI.

Ozbek, E, Garza, M, and Triantis, K (2009) Data envelopment analysis as a decision-making tool for transportation professionals. *Journal of Transportation Engineering*, **135**(11), 822-831.

Ozbek, E, Jesús, M, Garza and Triantis, K (2010) efficiency measurement of bridge maintenance using data envelopment analysis. *Journal of Infrastructure Systems*, **1**(31), 31-39.

Pearce, D W and Turner, R K (1990) *Economics of Natural Resources and the Environment*. New York: Harvester Wheatsheaf.

Raju, K and Kumar, N (2006) Ranking irrigation planning alternatives using data envelopment analysis. *Water Resources Management*, **20**(4), 553–566.

Ramanathan, R (2003) *An Introduction to Data Envelopment Analysis: A Tool for Performance Measurement*. New Delhi: Sage Publications India Pvt Ltd.

Ray, S (2004) *Data Envelopment Analysis Theory and Techniques for Economics and Operations Research*. Cambridge, UK: Cambridge University Press.

Ries, R, Melissa, G, Nuri, N and Kim, L (2006) The economic benefits of green buildings a comprehensive case study. *Engineering Economist*, **51**(3), 259-295.

Scheel, H (2000) *EMS Efficiency Measurement System User's Manual Version 1.3*. Dortmund, Germany: Universität Dortmund.

Vinter, G, Rozenes, S and Spragget S (2006) Using data envelop analysis to compare project efficiency in a multi-project environment. *International Journal of Project Management*, **24**(4), 323–329.

Vyas, G and Jha, N (2016) Identification of green building attributes for development of an assessment tool: Case of India. *Civil Engineering and Environmental Systems*, (Submitted - GCEE-2015-0124 R2).

Vyas, G, Jha, N, and Patel, D (2012) Development of a framework for green building rating system. *In*: S H Lodi, S M Ahmed, R U Farooqui and M Saqib (Eds.) *Proceedings of 3rd International Conference on Construction in Developing Countries (ICCIDC-III*), 4-6 Jul 2012, Bangkok, Thailand. Karachi, Pakistan: Department of Civil Engineering, NED University of Engineering & Technology.

Wakchaure, S and Jha, N (2011) Prioritization of bridges for maintenance planning using data envelopment analysis, *Construction Management and Economics*, **29**(9), 957-968.

UNDERSTANDING THE TERMINOLOGIES: DISASTER, CRISIS AND EMERGENCY

Hajer Al-Dahash[1], Menaha Thayaparan and Udayangani Kulatunga

School of the Built Environment, The University of Salford, The Crescent, Salford, M5 4WT, UK

Despite the fact that there is a difference between the terms disaster, crisis and emergency, they are closely interconnected, interdependent and overlap significantly. With a blurred line between the definitions of these terms, the mainstream literature uses the terms disaster, crisis and emergency interchangeably and in combination such as 'disaster crisis management' and 'crisis and emergency management'. The aim of this article is to systematically and critically review the arguments and counterarguments about the definitions of disaster, crisis, and emergency to date. A comprehensive literature review in the relevant field has been conducted in order to improve understanding of these phenomena. A qualitative conceptual content analysis has been carried out to establish the differences and similarities between disaster, crisis and emergency. The analysis reveals that the sudden nature of the event and the damage caused are the common features of all three terms, though emergency is not always of a sudden nature. Further, many common features have been identified between disaster and crisis, so that they can be used interchangeably up to a certain extent. The term emergency does not share many common features with the other two terms and has some contradictory features. Also, the authors conclude that both crisis and emergency would lead to disaster if the event were neglected or mismanaged.

Key words: disaster management, crisis management, emergency management, definitions

INTRODUCTION

It is widely acknowledged that preventing crises or disasters poses a challenge in managing such phenomena, because of their complexity and chaotic nature. Therefore, understanding the terms disaster, crisis, and emergency may lead to more effective strategies to reduce or stop the severity of their impacts on society and business, despite their complexity. Frequently, these terms are used interchangeably, but they actually could mean three very different phenomena (Lighthouse Readiness Group, 2015). To help improve understanding of such phenomena, an attempt has been made to untangle the concepts related to disaster, crisis and emergency. Accordingly, the paper is structured as follows: Firstly to define disaster, crisis, and emergency by reviewing key literature. Secondly, the nature of disaster, crisis, and emergency and their features have been explained. Finally, the main research question of the paper: "what are the differences and the similarities between disaster, crisis, and emergency?" is answered by highlighting the differences and the similarities between these terms. This study is an integrative review of the literature to systematically and critically evaluate the arguments and counterarguments about

[1] H.F.Al-Dahash@edu.salford.ac.uk

Al-Dahash, H F, Thayaparan, M and Kulatunga, U (2016) Understanding the Terminologies: Disaster, Crisis and Emergency. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1191-1200.

disaster, crisis and emergency to date, in order to enhance the current body of knowledge in this area. This integrative review is used to relate concepts and relevant arguments in order to advance and synthesise knowledge about these three terms. In doing so, the study reveals the nature of complexity in understanding the terminologies and contributes to improving the usage of such terminologies within the mainstream literature.

LITERATURE REVIEW

To identify the key research areas pertaining to disaster, crisis and emergency, a comprehensive literature has been carried out. The definitions of each of the terms have first been analysed followed by the cross analysis between the terminologies.

Disaster Definitions

The term disaster has been defined differently by various scholars due to the system by which they are explained and based on their causes and consequences. The United Nations Office for Disaster Risk Reduction (UNISDR, 2009) confirms that disasters occur as a result of a combination of hazards, vulnerabilities and a lack of measures, where using special measures for planning, coordinating and utilising appropriate resources will minimise the adverse impact of disasters (Alexander, 2003). Disasters are largely defined as sudden unforeseen events with natural, technological or social causes that lead to destruction, loss and damage (Alexander, 2005b; Jorgustin, 2012; Iyer and Mastorakis, 2006; Parker, 1992; UNSDR, 2009). Cutter (2003) states that disasters are normally on a singular large scale, and are high impact events. Some scholars have defined disasters as situations which overwhelm local capacity to withstand, cope and recover; necessitating external assistance and involving various stakeholders (Guha-Sapir, Vos, Below, and Ponserre, 2014; Lighthouse Readiness Group, 2015; Moe, Gehbauer, Senitz, and Mueller, 2007; Coppola, 2015; Parker, 1992).

Further, definitions of a disaster vary based on time and space, for example, disasters are considered as events concentrated in time and space, in which a society or one of its subdivisions undergoes physical harm and social destruction, so that all or part of the essential functions of such a society are impaired (Wilson and Oyola-Yemaiel, 2001; Fritz, 1961; Lindell, 2013; UNSDR, 2009). Furthermore, disaster is defined as "a dynamic mechanism that begins with the activation of a hazard and flows through the system as a series of events, in a logical sequence to produce a loss to life, property and livelihood by negatively influencing the emergency systems (Iyer and Mastorakis, 2006; Biswas and Choudhuri, 2012). Baker and Refsgaard (2007, 332) concentrated on systems' breach claims that institutional systems charged with the responsibility to manage disaster situations face multiple challenges, including the need for quick action and the accurate targeting of aid in an environment where information quality and quantity is highly unpredictable". Operationally, disasters exceed the capacity of normal, workday systems to cope with them effectively. Temporary systems of a different character must therefore be substituted.

However, disregarding the number of studies on the subject of disasters and disaster management, it seems that there is no universal definition of disaster used by all scholars and institutions (Shaluf, Ahmadun, and Said, 2003). The differences in the definition of a disaster are due to various causes and consequences and also appear to be affected by the geographic, economic and political situation of the respective countries (Eshghi and Larson, 2008) making it practically impossible to summarise in brief (Alexander, 2005a).

Crisis Definitions

This section analyses the definitions provided by various authors for the term 'crisis'. A crisis is "a disruption that physically affects a system as a whole and threatens its basic assumptions, its subjective sense of self, and its existential core" (Pauchant and Mitroff, 1992, 15). A crisis is stated as an abnormal situation which presents a high risk to business and may trigger rapid public policy changes, since it draws public and media attention and threatens public trust (Sawalha, Jraisat, and Al-Qudah, 2013; Shaluf *et al*., 2003; Alexander, 2005b). Booth (1993), cited in Moe and Pathranarakul (2006, 402), indicate that, "a crisis is a situation faced by an individual, group or organization which they are unable to cope with by the use of normal routine procedures and in which stress is created by sudden change".

Alexander (2005b) also argues that "the significance of crisis is its unexpectedness and uncontrollability which disrupts and/or impedes normal operations". Further, Shaluf *et al*., (2003) agree with Robert and Lajtha (2002) and Darling's (1994) view that each crisis situation is unique and so managers adjust and respond differently to each situation. In addition, the same situation may be a crisis at one time but not at another (Darling, 1994). According to Lighthouse Readiness Group (2015), a crisis is a "time of intense difficulty, trouble, or danger and can be personal, or confined to a small population, like a family, or a company dealing with a very serious problem". Crises often have past origins, and diagnosing their original source can help to understand and manage a particular crisis or lead to an alternative state or condition (Farazmand, 2001).

In an organisational context, crises are usually new situations to the organisation, often defined as unexpected, definitely unstructured and outside the typical operational framework of the organization (Beall, 2007). They are also characterized by an excessive amount of incomplete and conflicting information.

Emergency Definitions

A third terminology investigated in this paper is 'emergency'. Emergency is any natural or man-made situation that may result in substantial harm to the population or damage to property (Shen and Shaw, 2004, 2110). Emergency can be defined as "an imminent or actual event that threatens people, property or the environment and which requires a co-ordinated and rapid response. Emergencies are usually unanticipated, at least in terms of exactly what happens and when and where they take place. However, they can, and should, be planned for" (Alexander, 2005b, 159). Moreover, emergency is defined as a state in which normal procedures are suspended and extra-ordinary measures are taken to save lives, protect people, limit damage and return conditions to normal (Alexander, 2003; World Health Organization, 2002). Conversely, Eshghi and Larson (2008, 63) state emergency is "an event that may be managed locally without the need for added response measures or changes to procedure".

Further, concentrating on an immediate action, Jorgustin (2012) defines emergency as "an unforeseen combination of circumstances or the resulting state that calls for immediate action; an urgent need for assistance or relief". The Lighthouse Readiness Group (2015), while agreeing with Jorgustin (2012) about the fact that emergency could lead to a disaster if left unchecked, they also claim that not all disasters are preceded by an emergency. Alexander (2005b, 159) defines emergency as "a broader term that includes disasters, catastrophes and smaller disruptive events".

RESEARCH METHOD

As part of a systematic review of the literature, free flowing text was analysed using qualitative data analysis techniques. To critically review the arguments and counterarguments about disaster, crisis, and emergency, forty one definitions of these terms were investigated from twenty eight sources by using conceptual content analysis and cognitive mapping approaches. Conceptual content analysis, which focuses on identifying and examining the occurrence and presence of concepts and/or themes found within the text or sets of text (Busch *et al*., 1994 - 2012), was selected because it presents the opportunity to scrutinise the definitions from the literature so as to check the existence and frequency of a concept/theme. Significant desired raw information such as implicit or explicit data were extracted from texts or images by using this method.

Before making interpretation and valid inferences, such information has been organised into a systematic concepts (Busch *et al*., 1994 - 2012; Kulatunga, Amaratunga, and Haigh, 2007). The dominant concepts in the definitions are categorised into codes in order to find similar cognition under the same concept. The occurrences of selected terms within the definitions were identified where such terms could be implicitly or explicitly related to the chosen concepts. Moreover, to bridge the gap between raw data and theory building, a cognitive mapping technique was used by structuring the concepts and themes into a hierarchical network. As a result, the relationships between the supporting and surrounding information and the concepts/themes were made explicit.

The authors used qualitative data analysis software Nvivo 10 to manage the execution of content analysis and cognitive mapping for the study. After importing the definitions for disaster, crisis and emergency into NVivo 10, they were coded in three stages using open, axial, and selective coding processes (Corbin and Strauss, 1990). At the open coding stage, the key concepts/themes emerging from the information were assigned under established codes. Each of such codes in NVivo is called a 'node'. At the axial coding stage, the researcher reordered and categorised the nodes into groups by identifying the relationships between the codes. Thereafter, more elaboration and discussions were added to the set of codes by suitably extracting the relevant information to the concepts/themes established as part of the selective coding process which resulted in having a set of main themes and sub themes (see Figure 1).

FINDINGS AND DISCUSSION

Individual Analysis of Terminologies

Following the systematic literature review, a number of themes and concepts were coded for disaster, crisis and emergency, which are shown in Figure 1. Based on the established codes, cognitive maps were developed for disaster, crisis and emergency (refer to Figures 2, 3, 4). The analysed data on the terms disaster, crisis and emergency has been provided by understanding their real meanings and nature of complexity. As per Figures 2, 3, 4, there are ten main themes for disaster, nine for crisis, and ten for emergency, where the majority of these themes have sub themes.

The analysis on disaster definitions reveals that the key features of any disaster are its sudden nature, being unforeseen, causing loss and damage, coping capacity, system recovery, external assistance and involvement of multi stakeholders.

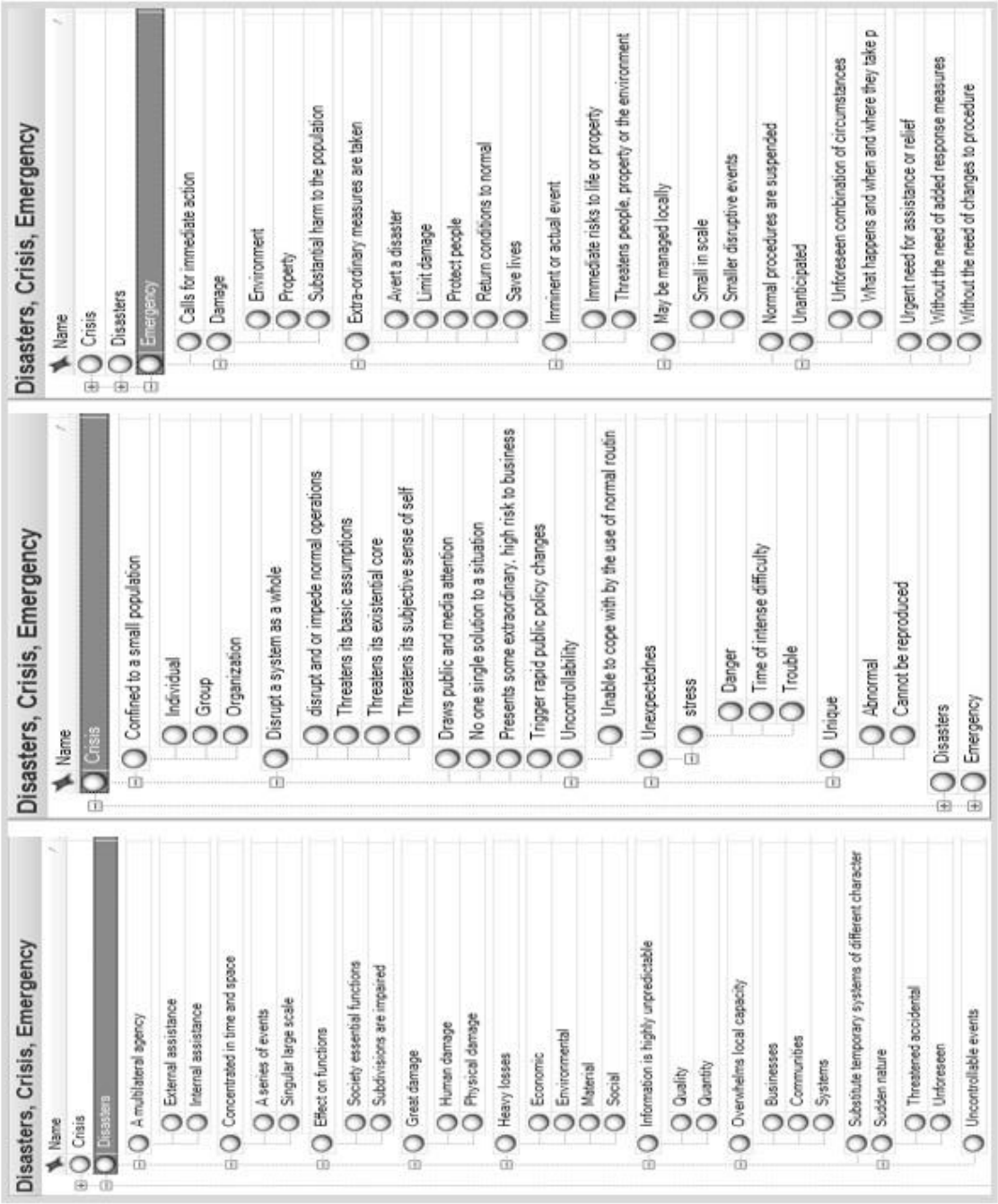


Figure 1: The main themes and sub themes for disaster, crisis and emergency

Figure 2 illustrates these features in a cognitive map. The literature synthesis on crisis definitions indicates that crises are generally associated with a system, organisation, and group of people or individual. The key features of a crisis are uniqueness, danger, being troublesome or causing damage, being unexpected, and usually emotional. Figure 3 illustrates these features in a cognitive map. The analysis on emergency definitions shows some level of contradictions such as the need for measures and being managed locally without any need for measures; unanticipated and imminent. This shows that the features of emergency can vary depending on the situation. For example, a power outage could lead to a sudden emergency, whereas a tsunami after an earthquake would indicate an imminent emergency situation.

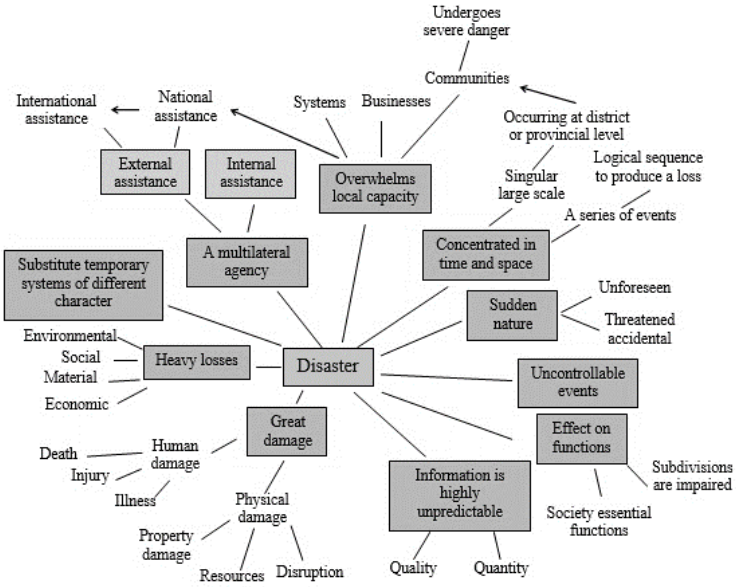


Figure 2: Cognitive map of disaster definitions

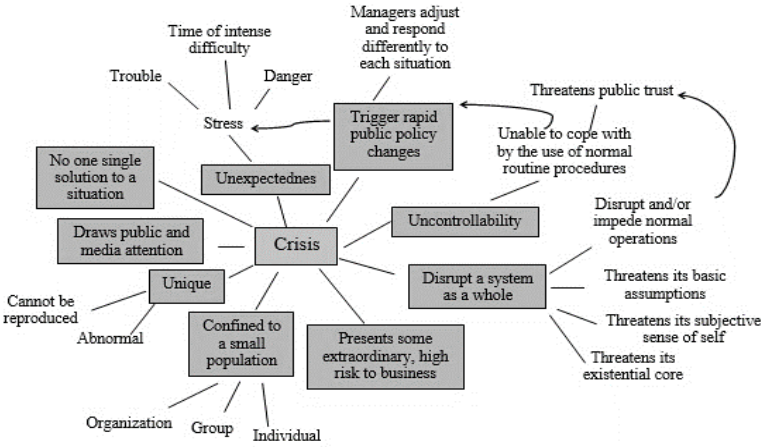


Figure 3: The Cognitive map of the Crisis Definitions

The main features associated with the term emergency are the nature of urgency, being unanticipated and imminent, creating damage, and immediate actions. Figure 4 further elaborates these features in a cognitive map.

Cross Analysis of Terminologies: Disaster, crisis and Emergency

This section presents the cross analysis of the terms disaster, crisis and emergency, to discuss the similarities and differences of such terms. Based on the cognitive maps, a set diagram was developed (see Figure 5) to identify the differences and similarities between disaster, crisis and emergency. What is interesting in this data is that the "sudden nature" and "damage" are the common features for the three terms disaster, crisis and emergency. The common feature between crisis and emergency is "confined to a small population". Although the difference between disaster and emergency is fairly vast (Jorgustin, 2012), they still have a common feature of having an "urgent need for assistance or relief". From Figure 5, it is apparent that there are comparatively more common features between disaster and crisis, such as being unique, uncontrollable, triggering rapid public policy changes, presenting something extraordinary, being a high risk to business, and disrupting a system as a whole. This clearly indicates that both disaster and crisis are quite similar in nature compared to that of emergency.

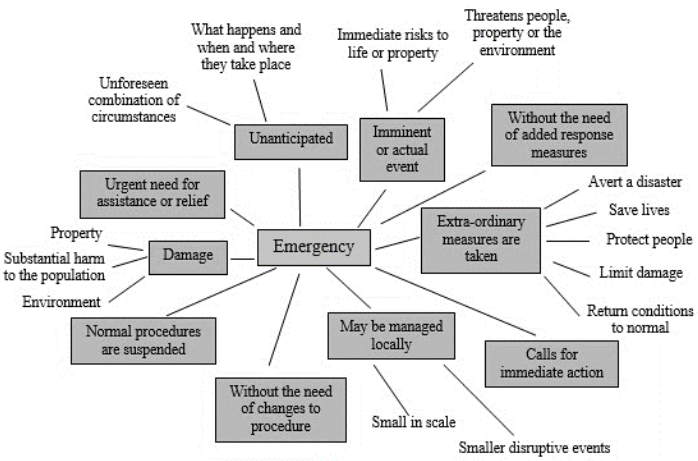


Figure 4: The Cognitive map of the Emergency Definitions

From the data in Figure 5, the unique features of emergency have some contradictions, for example, "emergencies are usually unanticipated" (Alexander, 2005b, 159; Jorgustin, 2012), and also can be imminent events (Alexander, 2005b, 159); there is no "need for added response measures" (Eshghi and Larson, 2008, 63) and conversely, "attention is focussed exclusively on measures" (Alexander, 2003, 118; World Health Organization, 2002, 10).

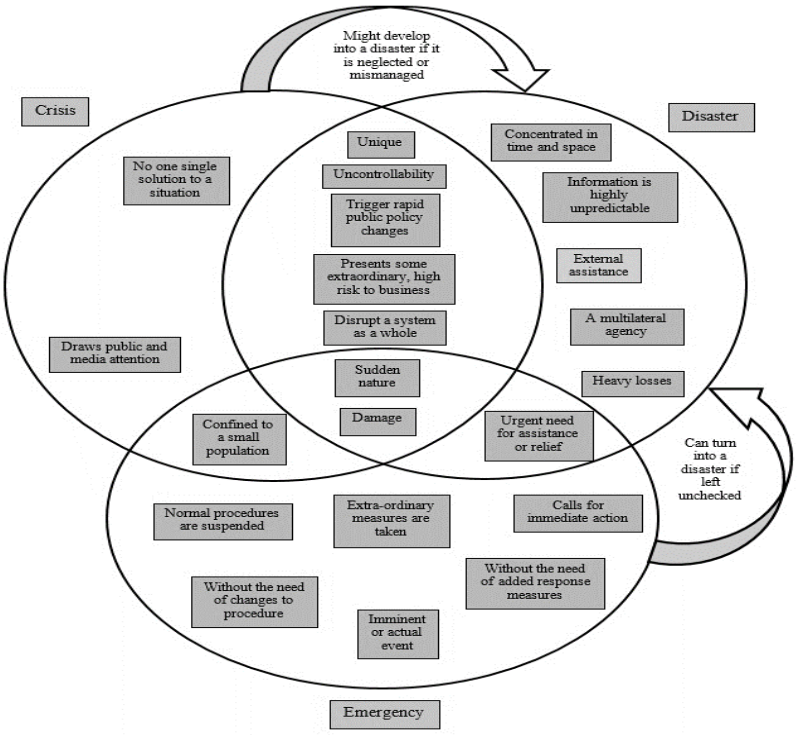


Figure 5: Set diagram for disaster, crisis and emergency

As such, it informs that features of emergency can vary depending on the situation. Further, it appears that emergency differs from disaster and crisis in the aspect where there is "no need for changes to procedure", however disaster and crisis "trigger rapid public policy changes". There is also a difference in timelines of the two events: a disaster has already happened, while an emergency can still be pending (Lighthouse Readiness Group, 2015).

Relationship between Disaster, Crisis and Emergency

Regarding the relationship between the terms, emergency is a situation that could lead to disaster if left alone or unattended or unchecked (Jorgustin, 2012) but not all disasters are preceded by an emergency (Lighthouse Readiness Group, 2015). A disaster may come quickly and without warning. Furthermore, a disaster will likely to affect more people and/or will have more devastating consequences than that of an emergency. An emergency can turn into a disaster, while a disaster is inherently an emergency situation, if noticed ahead of time. Not all bad results of an emergency will reach the level of disaster (Jorgustin, 2012). Moreover, research has shown that successful disaster management results primarily from the activities of emergency organizations (Quarantelli 1986, 2). Sawalha *et al*., (2013, 212) while agreeing with Shaluf *et al*., (2003, 29) say that a crisis might develop into a disaster if it is neglected or mismanaged. Farazmand (2001) agreed with this aforementioned view stating that, if crises are not managed successfully, it might lead to failures and further disasters. This view was also confirmed by the Lighthouse Readiness Group (2015) stating that a crisis is an event that is expected to lead to a dangerous situation, whether it is an emergency or a disaster.

According to Wilks and Moore (2004), it is important to make a practical distinction between risk, crisis and disaster management in describing potential shocks and threats to society. All risks have the potential of escalating 'out of control' and becoming a crisis; but most of them will not escalate if they are dealt with in a systematic manner. Baker and Refsgaard (2007) have a different point of view indicating that, if emergency response capabilities are pressed and their capacity is exceeded, a crisis situation can result. Consequently, if a crisis creates an unmanageable situation and the injury caused by the disturbance cannot be contained, disaster strikes. Jorgustin (2012) supports this view arguing that an emergency is a situation which may be an impending crisis.

CONCLUSIONS

The increasing number of disasters has stimulated researchers to understand the dynamics of disaster, crisis and emergency more than ever before. This research contributes to improving the understanding of the terminologies such as disaster, crisis and emergency, in disaster management literature. Frequently, these terms are used interchangeably, but they actually could mean three very different things. A comprehensive and systemic review of literature was undertaken to understand the nature and complexity of the terms disaster, crisis and emergency, and to further establish the similarities and differences of these terms to use them more effectively within the mainstream literature. The sudden nature of these events and the damage caused are the common features of all three terms, even though emergency does not always have to be of a sudden nature. In addition, the unique features associated with each term and the common features between two of the three terms were also identified. Accordingly, crisis and disaster share many common features compared to emergency, and as such they are closely interconnected. Further, the term emergency has some contradictory features of its own, which indicates the nature of the emergency can vary depending on the situation. Also, by analysing the relationships between the terms, the authors conclude that both a crisis and an emergency would lead to a disaster if neglected or mismanaged. As such, the whole idea of this paper is to provide analysed data on the terms disaster, crisis and emergency by understanding their real meanings and nature of complexity, so that the usage of these terms within the mainstream literature will be improved. Moreover, this paper contributes to

enhancing the knowledge and awareness of the community in improving their level of resilience.

REFERENCES

Alexander, D (2003) Towards the development of standards in emergency management training and education. *Disaster Prevention & Management: An International Journal*, **12**(2), 113-123.

Alexander, D (2005a) An interpretation of disaster in terms of changes in culture, society and international relations. *In*: R W Perry and E L Quarantelli (Eds.) *What is a disaster? New answers to old questions*. Bloomington, Indiana: Xlibris Corporation.

Alexander, D (2005b) Towards the development of a standard in emergency planning. *Disaster Prevention & Management: An International Journal*, **14**(2), 158-175.

Baker, D and Refsgaard, K (2007) Institutional development and scale matching in disaster response management. *Ecological Economics*, **63**(2), 331-343.

Beall, J (2007) Cities, terrorism and urban wars of the 21st century. London School of Economics: Crisis States Research centre Working Paper (Cities Theme).

Biswas, B C and Choudhuri, S K (2012) Digital information resources for disaster management of libraries and information centres. *Bangladesh Journal of Library & Information Science*, **2**(1), 12-21.

Booth, S A (1993) *Crisis Management Strategy: Competition & Change in Modern Enterprises*. London: Routledge.

Busch, C, De Maret, P S, Flynn, T, Kellum, R, Le, S, Meyers, B and Palmquist, M (1994 - 2012) *Content analysis*. Writing@CSU Colorado State University. Available from http://writing.colostate.edu/guides/guide.cfm?guideid=61 [Accessed January 4, 2016]

Coppola, D P (2015) *Introduction to International Disaster Management, Third Edition*. Amsterdam, Netherlands: Elsevier Inc.

Corbin, J M and Strauss, A (1990) Grounded theory research: Procedures, canons and evaluative criteria. *Qualitative Sociology*, **13**(1), 3-21.

Cutter, S L (2003) GI science, disasters and emergency management. *Transactions in GIS*, **7**(4), 439-446.

Darling, J R (1994) Crisis management in international business: Keys to effective decision making. *Leadership and Organization Development Journal*, **15**(8), 3-8.

Eshghi, K and Larson, R C (2008) Disasters: Lessons from the past 105 years. *Disaster Prevention and Management*, **17**(1), 62-82.

Farazmand, A (2001) *Handbook of Crisis and Emergency Management*. Boca Raton, FL: CRC Press.

Fritz, C E (1961) *Disaster*: Alexandria, VA: Institute for Defense Analyses, Weapons Systems Evaluation Division.

Guha-Sapir, D, Vos, F, Below, R and Ponserre, S (2014) *Annual Disaster Statistical Review 2013*. Centre for Research on the Epidemiology of Disasters. Brussels, Belgium: Université Catholique de Louvain.

Iyer, V and Mastorakis, Nikos E (2006) Important elements of disaster management and mitigation and design and development of a software tool. *In*: *Proceedings of the 7th WSEAS International Conference on Mathematics* and *Computers in Business* and *Economics*, June 13-15, Cavtat, Croatia, 102-121.

Jorgustin, K (2012) *Disaster and Emergency, What's The Difference?* Available from http://modernsurvivalblog.com/modern-survival-ideology/disaster-and-emergency-whats-the-difference/ [Accessed May 6th 2015]

Kulatunga, U, Amaratunga, D and Haigh, R (2007) Structuring the unstructured data: The use of content analysis. Paper presented at the *6th International Postgraduate Conference in the Built and Human Environment*, 27th-28th March, Salford, UK. Salford: University of Salford.

Lighthouse Readiness Group (2015) *The Difference Between a Crisis, Emergency and Disaster*. Available from http://lighthousereadiness.com/lrg/difference-crisis-emergency-disaster/ [Accessed June 6th 2015]

Lindell, M K (2013) Disaster studies. *Current Sociology*, **61**(5/6), 797-825.

Moe, T L, Gehbauer, F, Senitz, S and Mueller, M (2007) Balanced scorecard for natural disaster management projects. *Disaster Prevention & Management: An International Journal*, **16**(5), 785-806.

Moe, T L and Pathranarakul, P (2006) An integrated approach to natural disaster management: Public project management and its critical success factors. *Disaster Prevention and Management*, **15**(3), 396-413.

Parker, D (1992) The mismanagement of hazards. *In*: D Parker and J Handmer (Eds.) *Hazard Management and Emergency Planning: Perspective on Britain*. London: James and James.

Pauchant, T C and Mitroff, I I (1992) *Transforming the Crisis-Prone Organization*. San Francisco: CA: Jossey-Bass Publishers.

Quarantelli, E L (1986) Disaster crisis management. Paper presented at the *International Conference on Industrial Crisis Management in New York City, September 6, 1986*. New York.

Robert, B and Lajtha, C (2002) A new approach to crisis management. *Journal of Contingencies & Crisis Management*, **10**(4), 181-191.

Sawalha, I H S, Jraisat, L E and Al-Qudah, K A (2013) Crisis and disaster management in Jordanian hotels: Practices and cultural considerations. *Disaster Prevention & Management*, **22**(3), 210-228.

Shaluf, I M, Ahmadun, F and Said, A M (2003) A review of disaster and crisis. *Disaster Prevention & Management*, **12**(1), 24-32.

United Nations International Strategy for Disaster Reduction [UNISDR] (2009) *UNISDR Terminology on Disaster Risk Reduction*. Geneva: UNISDR. Available from http://www.preventionweb.net/files/7817_UNISDRTerminologyEnglish.pdf [Accessed March 16th 2016]

Wilks, J and Moore, S (2004) *Tourism Risk Management for the Asia-Pacific Region: An Authoritative Guide for Managing Crises and Disasters*. Report prepared by Asia-Pacific Economic Cooperation International Centre for Sustainable Tourism. Griffith University: Australia.

Wilson, J and Oyola-Yemaiel, A (2001) The evolution of emergency management and the advancement towards a profession in the United States and Florida. *Safety Science*, **39**(1), 117-131.

World Health Organization (2002) *Disasters and Emergencies. Definitions Training Package*. WHO/EHA Pan-African Emergency Training Centre, Addis Ababa.

BARRIERS TO BUILDING RESILIENCE TO EXTREME WEATHER EVENTS IN AUSTRALIAN HOSPITALS

Martin Loosemore[1] and Anumitra Chand

Built Environment, University of NSW, Kensington, Sydney, NSW 2052, Australia.

Many countries are facing a future of more regular extreme-weather-events (EWEs) and hospitals will play a critical role in managing the significant health impacts of such events. This study integrates organisational and infrastructure systems for the first time, to explore the barriers which exist, in making Australian hospitals more resilient to EWEs. Employing a single in-depth case study of a major Australian tertiary hospital which has experienced significant EWEs, data was collected using semi-structured interviews, observations of disaster drills and disaster planning meetings, as well as additional documentary analysis of past incident reports. Findings indicate that disaster planning is compliance-driven, under-resourced, ad-hoc and non-inclusive. There is also widespread ignorance among key stakeholders of the influence of hospital design in delivering healthcare to the community during a EWE event. It is concluded that disaster management planning needs better resourcing and that procedures, systems and technologies must be put in place to foster better stakeholder communication around hospital facility disaster planning for EWEs.

Keywords: Australia, extreme weather, disaster, hospitals, planning, resilience.

INTRODUCTION

It is anticipated that Australia and most other countries will have more frequent extreme weather events (EWEs) such as heatwaves, floods and storms in the future (AAS, 2015). Resilience refers to the ability of an individual, group or organisation to adapt to such shocks and return to normal (Gunderson and Holling, 2002, Holling, 2001). As WHO (2015) points out, when such events strike, the resilience of health services is a matter of life and death. However, many hospitals have not been designed with EWE threats in mind (Carthey *et al.*, 2009), despite significant evidence that damage to health infrastructure can be enormous during such events. There is currently little understanding of the resilience of physical hospital infrastructure to EWEs (Achour *et al.*, 2014). Most of the research has been undertaken into health system organisational resilience although recently, some studies have started to highlight the importance of 'hard' health infrastructure, albeit in exclusion of the buildings themselves. For example, Zhong *et al.* (2015) identified a wide range of factors that could be used for assessing hospital resilience across eight domains, 17 subdomains, and 43 indicators. WHO (2015) also acknowledges that the building system has a major impact on the safety of patients during a disaster. In assessing the safety of a hospital during such events, WHO evaluates numerous potential built infrastructure risks such as the type of design, structure, construction materials, and

[1] m.loosemore@unsw.edu.au

Loosemore, M and Chand, A (2016) Barriers to Building Resilience to Extreme Weather Events in Australian Hospitals. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1201-1210.

critical components of the structure. It also considers a number of non-structural elements such as the facings, doors and windows to determine their vulnerability to water; the impact of flying objects; the safety of access to the facility and internal and external traffic; the lighting and fire protection systems; and false ceilings. Importantly, it also considers how hospital personnel are organised to respond and to function during and after a disaster, taking into account the general organisation of hospital management, availability and implementation of disaster plans and programs, resources for disaster preparedness and response and the level of training and disaster preparedness of the staff etc. Normally, considerations of built infrastructure are separated from research into organisational resilience. However, WHO (2015) shows that in reality these are inseparable since a critical aspect of re-organising for an EWE are considerations around the capacity of physical infrastructure to adapt, learn and perform in this new disaster setting. To this end, the aim of this study is to use contemporary resilience and learning theories to explore how hospital stakeholders learn from disaster response experiences and how these lessons inform future hospital disaster management planning around built infrastructure.

COLLECTIVE LEARNING ABOUT BUILT INFRASTRUCTURE RESILIENCE TO EWES

Learning is the process of acquiring new, or modifying and reinforcing, existing knowledge and skills which produces relatively permanent changes in values, attitudes and behaviours (Argote and Miron-Spektor, 2011). Organisational learning is the process by which its members collectively learn and adapt its structure and performance, and remain either functional or competitive in response to external pressures (such as EWEs) (Wang and Ahmed, 2003). As organisations grow, they lose their capacity to learn as company structures and individual thinking becomes rigid, losing the critical elements that facilitate learning such as co-operation between individuals and groups, a shared vision, a holistic view, free and reliable communication, and a culture of teamwork and trust (Senge, 1990, Argyris, 1999). Argyris and Schon (1978) show that organisational learning occurs at three key levels: individually; collectively; and organisationally. Their work, translated to a hospital and EWE context suggests when new individual knowledge generated as a result of learning is internalised and shared between different hospital stakeholders it becomes collective knowledge, bringing about mutually understood changes in behaviours, values and preferences. This collective learning should then lead to changes in a hospital organisation's formal organisational systems, procedures and processes, as documented in its formal disaster management plans. More recent research into new institutionalist (NI) theory.(Lowndes, 2005) shows that effective organisational learning will also need to bring about changes to an organisation's *informal* rules, norms and procedures which in contrast to formal rules are unwritten and created, communicated, and enforced outside officially sanctioned channels. Importantly, informal rules tend to be more 'sticky' and resistant to change than formal rules since they are hidden, under-the-surface and taken-for-granted. Indeed, NI theory shows that if they do not change in response to a EWE then they may act to undermine changes to formal rules or replace them when the changes to formal rules are not seen as adequate by organisational stakeholders.

Another perspective useful for exploring hospital learning in response to EWEs is Wang and Ahmed's (2003) which shows that organisational learning can take place at three levels: single loop learning; double loop learning and; triple loop learning. All three levels of learning are necessary in responding to a EWE but it is the deeper

changes afforded by triple loop learning that are the most challenging to bring about. Single-loop learning is the lowest level of learning where individuals might 'react' to a situation and make small changes to specific practices or behaviours without examining or challenging our underlying reasons behind them. In a hospital, this may involve minor operational changes at the ward level to take more patients presenting as a result of a EWE. Double-loop learning is a deeper form of learning which addresses the causes of a problem and involves changing the underlying practices and procedures which lead to it. In a hospital, this may involve adapting the disaster management plans in response to a EWE (equivalent to changing the formal hospital rules under New Institutional Theory). Triple-loop learning is the deepest form of learning which involves 'unlearning' fundamental principles which might have led to those causes taking place. In a hospital these might be assumptions about the role of hospital infrastructure is responding to a EWE.

METHOD

Informed by theories outlined above, the process by which hospital stakeholders learnt about the role of hospital infrastructure in responding to a EWE was investigated through a single case study of a major Australian hospital network of four hospitals where there was a history of EWEs.

Using purposive non-probability sampling, fourteen respondents were selected for interview on the basis of their past experience of EWEs, their responsibilities for health facility management and planning and involvement in disaster management planning processes. These included: General Manager / Disaster Controller; Quality Manager; Physical resources Manager (Facilities Manager); Business and logistics Manager; Operations Manager (DON); Allied Health Manager; Clinical manager; Mental health acting manager; Environmental Manager; Emergency Department Director; Nurse Unit Managers (Surgical, Medical and ED); Nursing Managers (2); Senior ambulance service representative; and District Disaster Nurse Consultant. Disaster committee meetings and disaster management drills were also observed to understand of how different hospital stakeholders would come together to deal with disaster management challenges during an EWE and how collective learning and socialisation occurred in developing their future response strategies in relation to the built environment. Documentary analysis of Disaster Committee meeting minutes, disaster management plans, archival records of past events and post disaster and debriefing reports was also analysed to evaluate both printed and electronic documents where this tacit knowledge about the built environment had been made explicit. (Angen, 2000) before detailed qualitative analysis using content analysis.

These datasets were recorded in three categories: the transcript (the interview data), supported by field notes of personal reflections (observation data) and analytical memos (incorporating both data sets supplemented by the documentary analysis data). The final phase of data collection involved focus groups to present the preliminary findings to respondents for their feedback as a form of 'member-checking' to confirm the validity of the findings Informed by the literature above, the coding framework identified the coding variables such as staff capacity (to learn, to plan, to cope), structural and non-structural factors (such as building fabric, services, etc.) network capacity (to support hospital services and medical transfers) and organisational capacity (to deal with and prepare for EWEs). Qualitative data was also analysed using narrative analysis.

In this research the level of analysis was 'individual' respondents qualified by virtue of the sampling process described above. As Reissman (2008) points out, the key skill in good narrative analysis is an ability to produce a good narrative account on a phenomenon (in this case learning about built environment vulnerabilities to EWEs) by stitching together multiple insights of the various key stakeholders affected (in this case, the various members of the Disaster Management Planning Committee). Although there is some dispute among researchers who conduct narrative analysis about whether the product of narrative analysis should also be narrative or quantitative (Clandinin and Connelly, 2000), in presenting the results of this research it was decided to summarise the narrative of the discussions in selected quotes rather than reduce the data to quantitative counts of variables. As Meisel (2011: 2023) argues, the power of using narrative to report results is in translating respondent accounts into data that people can comprehend and understand by building a story around it. To this end, a narrative of the combination of data described above is presented below, drawing on selected insights from the interviews, analytical memos, documentary analysis and observations.

RESULTS AND DISCUSSION

The results highlighted three major vulnerabilities faced by the case study network hospitals. These were: Hospitals site and area vulnerabilities; Hospitals built environment vulnerabilities; and Hospitals organisational vulnerabilities. This closely reflects the WHO (2015) hospital safety assessment categories, although structural and non-structural building elements were not differentiated in the data. Site and area vulnerabilities relate to challenges created in responding to a EWE by the hospital site and broader surrounding hospital environment (surrounding infrastructure, typography, roads, rivers etc.). Built environment vulnerabilities relate to the structure, non-structural and services components of a hospital (structure, built fabric, power, water and telecommunications systems etc.). Organisational vulnerabilities are the organisational resources and structures or systems for disaster management (staff, supplies, emergency services etc.).

These vulnerabilities were identified by individual respondents from various backgrounds and thus were not collectively realised by all the key hospital disaster planning stakeholders. Failing to include all the key hospital disaster responders in disaster planning process further compromised the externalisation of various lessons learnt to be included in hospital disaster plans. Although hospital networks disaster management planning is coordinated by a multi-agency committee, the isolated understanding of the vulnerabilities and the lessons learnt from these vulnerabilities influenced the development of individual agencies disaster plans in 'silo' causing inter-agency coordination problems during an EWE, as indicated by a respondent.

> We do disaster planning [but] it will be contained at the local level …and that's very much silo, in a silo in that respect.

The lack of awareness and understanding of the built environment vulnerabilities amongst the hospital disaster planning stakeholders show their ignorance of built infrastructure's role when responding to EWEs. The impact of EWEs on buildings and how it influences hospital service delivery is not well understood. In addition, the current disaster and facility management practices that occur on isolation restrict built infrastructure vulnerabilities being integrated into organisational disaster planning process.

> We are human services, so our primary concern, and what we do in a disaster response, is going to be about people. We worry about people and what we doing about service delivery, that's the primary focus. If we gave it to [physical resources] and said you write a disaster plan, [they] would come [to] it with a different perspective. But [they are] not writing the disaster plan because we are doing it from a template, people who filling in the content largely are the people [in] service delivery, so that's what they think about, so maybe have the physical resources a section [called the] physical resources disaster plan response.

The findings indicate that despite evidence of increasing EWEs in the area, the hospital networks disaster planning focused on man-made type disasters, making disaster management planning compliance-driven. This according to our findings is potentially created by lack of resources for adaptation, path dependencies related to past disaster management experiences and strict delineations of responsibilities for doing so. Aside from that disaster planning can be very time consuming when people are pressed with time to focus on service delivery.

> …yeah, we have a bit of a blitz every time that we go through numerical profiling or accreditation, then it dies off and I would say you do not think about it for the next couple of years until the next round comes around.

> We are human services, so our primary concern, and what we do in a disaster response, is going to be about people. We worry about people and what we doing about service delivery, that's the primary focus.

The identification of three inter-related categories of vulnerability and the flaws in hospital disaster management planning support Loosemore *et al.*'s (2012) and Achour *et al.*'s (2014) calls for a more holistic approach to health facility and disaster planning management which better integrates the organisational and built environment aspects of hospital resilience. However, the findings also indicate that such holism will require a paradigm shift in hospital disaster management, which currently excludes built environment considerations from mainstream disaster management and planning processes. In addition to emphasising the need to involve all relevant hospital stakeholders in disaster management planning, our findings also demonstrate that learning from past involvement in responding to EWEs at individual, collective and organisational levels is vital in enhancing hospital resilience to EWEs. The findings support Argote (2011) who argued that experience is the foundation of knowledge creation in any organisation. These experiences can either be acquired during EWEs or through regular disaster training exercises and drills. This was reinforced by many of our respondents as indicated in the statements below:

> What I might learn would be different to [what] someone else might learn. What I saw as expense is different to [what] others see as expense. What I saw as bad someone else said no, that wasn't bad. So everyone could have a different experience and different learning. I might learn different things to the business manager next door.

> It's really going to be the experiences that will inform the next level of the document [disaster plans] and I understand the responsibility to communicate that and I probably want to share that with my colleagues in conference [and] forums.

Certainly had enough runs [with disasters]…So part of [disaster management] is practising and also reflecting when you have had an event.

> Training and education initiatives are run to test the plans, conduct training and exercise, practice based learning…and based on the lesson learnt the plans are revised.

> What I tend to find is that people who work on site for a long period of time carry a lot of knowledge in their head .

The results also emphasise the significant role of the feedback process which allows the individuals lessons to be shared collectively across hospital internal and external stakeholders. According to Edson (2012) the feedback process is necessary as collective reasoning provides the diversity of adaptation options which increases flexibility in planning. Additionally, our results indicated that not all the lessons learnt individually were captured at the hospital organisational level. This finding emphasises the need to improve the feedback process by developing appropriate knowledge management structures and tools that not only capture lessons learnt but also allow effective use and sharing of information across the multiple stakeholders involved in disaster planning. This need to improve stakeholder management, engagement and consultation processes is a new potentially valuable avenue of action and research which needs to emerge from our findings. Our findings support Heng *et al.*'s (2005) social network analysis of health facilities managers which shows that they are too often disempowered and excluded from disaster management processes. As Bosher *et al.* (2009) explained, in the past the lack of clarity in the responsibilities of the various stakeholders and how they relate to each other has reduced a hospital's capacity to support its services delivery. Furthermore our respondents emphasised the importance of improving the process for knowledge recording and sharing across the hospital network (both vertically and horizontally), as indicated by the quotation below.

> It's about really sharing of information and taking it up. You still have to create opportunities [for knowledge sharing] because there's a huge amount of people who have got insights out there after these sorts of [disasters] and you really have to make an effort to gather them.

> If we could get more down into the ward level [to gather knowledge]… Part of what you need is the right people or the right positions in the planning group. [A] lot of corporate knowledge was walking out the door, so I sat down with a couple of [staff] and we nutted out a basic template for the things that needed to be identified… What I tend to find is that people who work on site for a long period of time carry a lot of knowledge in their head.

Our findings also emphasise the need to develop a process for collecting and sharing disaster information across multiple agencies which may be spread over a wide geographical area controlled by different governance systems and structures. Given these governance systems often conflict and overlap (Loosemore *et al.*, 2013), our research supports the need for further research into possible new communication technologies which can better facilitate the cross agency capture, distribution and use of information in responding to an EWE (Nonaka *et al.*, 2000, Niu, 2010). Whether technologies such as Business Information Modelling can facilitate this process and contribute to better disaster management is something that needs to be explored by future research. This avenue of research is supported by Mathew (2005) who has discussed the potential role information technology plays in facilitating collection and dissemination of information efficiently during health disasters, as well as post disaster evaluation.

Importantly, our findings also support a greater exploration of NI theory as a conceptual tool to explore responses to EWEs (Lowndes, 2005, Mahoney and Thelen, 2010). The results show that it is not just necessary to change the formal rules and procedures in building a hospital's resilience, but that there is also a need to reinforce the many unwritten rules that support hospital resilience to EWEs.

> I suppose [there's] a lot of unwritten rules that we have, or norms that we have here. If there is a flood, people that can get in would ring and sort of say they are available to come in to work, or something like that… We share staff (R2).

For example, our research suggests that smaller healthcare facilities in a network that formally relied on the referral hospital for disaster coordination, developed their own emergency contact lists of people that can provide quick information or support during an event. The smaller facilities indicated that the Disaster Control Centre at the referral hospital was unable to provide relevant information or support quickly enough for their needs which created disaster response challenges for these facilities. They emphasised that while they still coordinate their disaster planning through the Disaster Control Committee, they also needed some independence to move outside these formal systems to coordinate their disaster response efficiently. Unwritten rules were also created to move staff between the four network facilities and to accommodate both staff and visitors stranded on-site. The difficulty with using the DMPs during 2009 flood events led to the development of an emergency response checklist or action cards for all triage staff at the referral hospital.

> So these are the action cards or checklists created for triage team to assist them during an emergency. The triage team can pin the card to their uniform and it provides a quick guide of what they need to do.

> I actually like the action cards because we have got our delegation stuck in our emergency document that is pages long. You do it for triage in medical emergencies but actually [we can] have it for disaster planning and response.

This finding around the role of informal rules provides an entirely new perspective on the hospital resilience debate and suggests that past analyses may have been overly focussed on *formal* rules and policies and that new insights might emerge through a fuller examination of how *informal* organisational rules, norms and practices operate in conjunction with or to undermine formal rules in determining hospital resilience to EWEs.

Finally, in support of much disaster management literature our results show that inefficient communication is a common pitfall described in the (Unlu *et al.*, 2010).

> There was a lot of unhappy staff who were very unhappy with management at the time basically saying that they should have warned the staff more … so it was a lot of blaming post event over [lack of communication]. Talking to people post the event some people were aware that something was going to happen by other sources outside of the hospital, so yeah, there was no real warning.

> Our biggest communication issue is getting accurate roads information which makes it very difficult because in rural area we have major roads that are covered by roads and maritime then you have ummm council roads, so you have two different people who are responsible for road closure and opening and all those sorts of things.

However, this research extends the literature by focusing on the need for hospitals to also better manage the lateral incursion of information across the network during EWEs. During the 2009 flood event, lateral communication from outside unknown sources amongst staff and visitors created major challenges for the hospital facilities in coordinating their disaster response. The lateral communication caused panic and anxiety amongst staff and visitors, which the hospital was unprepared to deal with. The participants recognised the need for a more structured response to deal with the lateral information and to develop their communication processes.

> The other thing is that we are getting a lot more lateral [communication] coming into it, especially from social media. And so we are not controlling the communication and you are not sure of the accuracy of that information. That's why we really need to be

> sure that our communication, particularly within our organisation and externally to our stakeholders is really clear.
>
> I think the key is when you actually instigate the disaster response then, it should be very clear where the information flow should be (and you know up and down essentially). So if your staff is getting information from wherever, they shouldn't just be thinking ok, I'll leave now, they should be then saying ok this is the information I have got and I am giving it to you and I need a direction. I think it's something that probably requires a little bit more development.

CONCLUSIONS

The aim of this study is to use contemporary resilience and learning theories to explore how hospital stakeholders learn from disaster response experiences and how these lessons inform future hospital disaster management plans. Research was undertaken through interviews with seventeen senior respondents involved in hospital disaster management processes, observations of disaster drills and analysis of disaster management records. The results provide useful new insights into the way that people from different backgrounds learn lesson from their individual experiences, however fail to share their lessons and understanding of the three vulnerabilities collectively with the key stakeholders involved in hospital disaster management process, influencing what goes in their disaster plans and creating potential challenges for inter-agency disaster response coordination.

While the findings must be interpreted within the clear limitations of the single case study, they indicate that if hospital facilities are to be made more resilient in the future then a paradigm shift is required in disaster management planning that is driven by a more holistic approach, supported by new systems, technology and governance structures. The newly exposed inter-relationships between site, area, built infrastructure and organisational vulnerabilities and the finding that health facilities managers are often excluded from disaster management learning processes adds to our limited understanding of how built infrastructure lessons are learnt in response to EWEs.

Our findings also stress the importance of regular disaster training exercises and drills to enable hospital managers to explore these system failings further so that individual lessons learnt during EWEs (either real or simulated) become collective learnings and in turn influence organisational responses at both a formal and informal level. Finally, the findings around the role of informal rules provides an entirely new perspective on the hospital resilience debate and suggests new avenues for future research in this important area.

REFERENCES

Australian Academy of Science (2015) *Climate Change Challenges To Health: Risks And Opportunities*, Canberra: ACT.

Achour, N, Miyajima, M, Pascale, F and Price, A D (2014) Hospital resilience to natural hazards: classification and performance of utilities. *Disaster Prevention and Management*, **23**(1), 40-52.

Angen, M J (2000) Evaluating interpretive inquiry: Reviewing the validity debate and opening the dialogue. Qualitative Health Research **10**(3), 378-395.

Argote, L (2011) Organizational learning research: Past, present and future. *Management Learning*, **42**(4)**,** 439-446.

Argote, L and Miron-Spektor, E (2011) Organizational learning: From experience to knowledge. *Organization Science*, **22,** 1123-1137.

Argyris, C (1999) *On Organizational Learning*, 2nd edition. Malden, Mass.: Wiley-Blackwell.

Argyris, C and Schon, D A (1978) *Organisational Learning: A Theory of Action Perspective Reading*. MA: Addison-Wesley Publishing Company.

Bosher, L, Dainty, A, Carrillo, P, Glass, J and Price, A (2009) Attaining improved resilience to floods: a proactive multi-stakeholder approach. *Disaster Prevention and Management*, **18**(1), 9-22.

Carthey, J, Chandra, V and Loosemore, M (2009) Adapting Australian health facilities to cope with climate related extreme weather events. *Journal of Facilities Management*, **1**(7), 36-51.

Clandinin, D J and Connelly, F M (2000) *Narrative Inquiry: Experience and Story in Qualitative Research.* San Francisco: Jossey-Bass Publishers.

Edson, M C (2012) A complex adaptive systems view of resilience in a project team. *Systems Research and Behavioural Science*, **29,** 499-516.

Gunderson, L and Holling, C (2002) *Panarchy: Understanding Transformations in Human and Natural Systems.* London: Island Press.

Heng, S, Loosemore, M and McGeorge, D (2005) Beyond strategy: An investigation of the brokerage role of Facilities Managers in the Australian health care sector. *Journal of Health Organisation and Management*, **19**(1), 16-32.

Loosemore, M, Chow, V and Harvison, T (2013) Inter-agency governance risk in managing hospital responses to extreme weather events in New South Wales, Australia: A facilities management perspective of shared situational awareness. *Construction Management and Economics*, **31**(10), 1072-1082.

Loosemore, M, Chow, V W and McGeorge, D (2012) Modelling the risks of extreme weather events for Australasian hospital infrastructure using rich picture diagrams. *Construction Management and Economics*, **30**(12), 1071-1086.

Lowndes, V (2005) Something old, something new, something borrowed: how institutions change (and stay the same) in local governance. *Policy Studies*, **26**(3), 291-309.

Mahoney, J and Thelen, K (2010) *Explaining Institutional Change: Ambiguity, Agency, and Power*. Cambridge: Cambridge University Press.

Mathew, D (2005) Information technology and public health management of disasters: A model for South Asian countries. *Prehospital Disaster Medicine*, **20**, 54-60.

Meisel, Z F and Karlawish, J *(2011) Narrative vs Evidence-Based* Medicine-And, Not *Or*. *Journal of the American Medical Association*, 306(18): 2022-2023.

Niu, K H (2010) Knowledge management practices and organizational adaptation: Evidences from high technology companies in China. *Journal of Strategy and Management*, **3**(4), 325-343.

Nonaka, I, Toyama, R, and Konno, N (2000). SECI, *Ba* and leadership: a unified model of dynamic knowledge creation. *Long Range Planning*, **33**(1), 5-34.

Reissman, C K (2008) *Narrative Methods for the Human Sciences*. London and Thousand Oaks: Sage Publications.

Senge, P M (1990) *The Fifth Discipline*. London: Century Business.

Unlu, A, Kapucu, N, and Sahin, B (2010) Disaster and crisis management in Turkey: a need for a unified crisis management system. *Disaster and Crisis Management*, **19**(2), 155-174.

Wang, C L and Ahmed, P K (2003). Organisational learning: a critical review. *The Learning Organization: An International Journal*, 10 (1), 8-17.

World Health Organisation (2015). Hospital Safety Index: Guide for Evaluators. Switzerland: World Health Organization and Pan American Health Organization.

Zhong, S, Clark, M, Hou, X Y and Fitzgerald, G (2014) Development of key indicators of hospital resilience: A modified Delphi study. *Journal of Health Services Research Policy*, **20**(2), 74-82.

VALUE AND PERFORMANCE MANAGMENT

EXPLORING THE ATTRIBUTES AND KPI'S ADOPTED BY INTERNATIONAL HEALTHCARE PROVIDERS TO MEASURE THE PERFORMANCE OF THEIR ESTATES AT THE STRATEGIC LEVEL

Laura Rodriguez-Labajos,[1] Craig Thomson[2] and Geraldine O'Brien[3]

[1&2] *Engineering & Built Environment, Glasgow Caledonian University, Cowcaddens Road, Glasgow, G4 0BA, UK*

[3] *Health Facilities Scotland, NHS National Services Scotland, 3rd Floor, Meridian Court, 5 Cadogan Street, Glasgow, G2 6QE, UK*

The requirements to improve the healthcare estate driven by changes in government priorities, the evolving healthcare agenda, and ever tightening budgets are asking estate managers to question what a good health estate looks like. It is crucial to develop a framework that supports providers to define the optimum performance of their estates needed to achieve best value, and ensure it reflects best practice. In this research the estate performance measurement and monitoring approaches for nine international healthcare organisations are reviewed, to identify the attributes and key performance indicators (KPIs) that are currently in use and to assess whether they can form the baseline for the approach to developing the framework. The findings show that each organisation employs a list of KPIs that are aligned and tailored to their contextual priorities and policies. Despite the differences between them, the research reveals that there is a common set of attributes and KPIs that are applied by the majority of the healthcare organisations reviewed. The next step of the research seeks to widen the sample and explore the rationale for this through a pan EU survey and focus groups.

Keywords: facilities management, healthcare estate, key performance indicators, performance measurement

INTRODUCTION

During the last few decades healthcare organisations have recognised the importance of making the best use of resources and expensive assets such as healthcare estates. The NHS in Scotland places special focus on increasing estate performance through the reduction of maintenance backlog, but also by seeking to reduce the number of underperforming, excess and underutilised facilities, thus ensuring buildings retain functionality and flexibility even within an increasingly ageing estate. These combine to affect the overall performance of the estate, and as healthcare budgets become increasingly constrained and contested it is critical to make the right decisions on how and where to allocate the resources to achieve best value. This, together with the shift to new models of care, the increasing demand for improving quality and the growing interest in patient satisfaction has brought up a debate in Health Facilities Scotland

[1] laura.rodriguez-labajos@nhs.net

Rodriguez-Labajos, L, Thomson, C and O'Brien, G (2016) Exploring the Attributes and KPI's Adopted by International Healthcare Providers to Measure the Performance of Their Estates at the Strategic Level. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1213-1223.

(HFS) about what performance attributes of estate and facilities services need to be measured and monitored as a basis for strategic decision making in order to improve the value which is delivered.

This paper presents the first phase of a collaborative research project with HFS which attempts to establish if there is a common set of performance attributes which healthcare providers need to measure and monitor in order to inform their management of the estate. The main project aims to establish a framework that supports healthcare providers to define the optimum performance at which their estates deliver best value reflective of their own contexts, thus reflecting organisation goals, stakeholder values and to deliver better healthcare for patients. The resulting framework will provide healthcare organisations with a reliable tool for strategic decision making, planning and resource allocation. Presented are the findings of a comparison of the attributes and KPIs adopted for performance measuring and monitoring by a selected group of nine international healthcare organisations revealing a common set of attributes but also identifying contextual differences. The findings from this first phase provide the foundation for phases 2, 3 and 4 which will be outlined and undertaken during the next two years.

Clarifying the terminology

In the context of healthcare when it comes to asset performance it mostly refers to physical assets which include land, building, medical equipment, fleet, IT & software; whereas 'estate' refers to the assets relating to land and building. This research is limited to estate assets and facilities services (laundry and linen, pottering, catering and cleaning), as the inclusion of all the physical assets into the future planned framework would generate an excess of data that can lead to confusion for the context of improving the performance of the estate; and considering also that in practice this is the way HFS define their performance monitoring framework. For the intention of this paper, when talking about estate, it refers to land, building and facility services.

Best value is understood to reflect the best use of the estate before its absolute need for replacement whilst delivering a better healthcare and achieve organisational goals.

Estate performance measurement and monitoring

Performance measurement provides the basis for an organisation to assess how well they are progressing towards their predetermined objectives, helping to identify areas of strengths and weaknesses, and support in the allocation of resources with the goal of improving organisational performance (Purbey *et al*., 2007; Amaratunga and Baldry, 2002). Different tools for assessing facilities performance are offered in the literature including post occupancy evaluation, performance measurement systems based on KPIs, the balance scorecard, facility performance evaluation, etc. Performance measurement systems based on KPIs provide the focus for this first phase of the research, as these KPIs are performance measures tightly linked to an organisation's strategy (Fitzgerald *et al*., 1991), provide a wider coverage of scope, inform decision makers about where to best focus resources to support performance, and they are the preference for HFS. A later phase of the research will review and analyse on the themes and measures provided in the other tools such as Post Occupancy Evaluation (POE), and facility/building performance evaluation.

Previous studies

The review of the literature reveals that there is extensive research conducted into facility performance management. Hinks and McNay (1999) classified a list of 172

KPIs under eight categories: business benefits, equipment, space, environment, change, maintenance/services, consultancy, and general. Meng and Minogue (2011) identified the ten most important performance indicators for facilities management, including cost -effectiveness, response time, service reliability, health, safety, environmental compliance, staff commitment, client-service provider relationship and IT application. However, research considering the link between facility performance management and its measurement and monitoring is less mature. Brackertz (2004) developed a performance measurement tool for facilities in local governments that consists of six perspectives: service, physical, community, financial, utilisation and environment. In another study Lavy *et al*., (2010) presented a literature-based list of categorised KPIs that covers the assessment of facility performance, breaking down the KPIs into four major categories: financial, physical, functional, and survey-based. Shohet *et al*., (2014) reduced the list to seven core KPIs for facility's performance assessment, including maintenance efficiency, replacement efficiency, condition index, functional index, indoor/outdoor environmental quality, absenteeism and user perception.

Talib *et al*., (2013) identified 11 areas for assessing the buildings performance distributed among three categories: functionality (design, utility, access), impact (outlook, core activities, facility, future design) and quality (building, engineering, performance, energy). To date, only limited research has explored performance measurement for healthcare build facilities, with Pullen *et al*., (2000) exploring seven key performance indicators (KPIs) applied in Australian hospitals but these were all business oriented and none related to the physical performance of the estate. Shohet (2006) proposed an integrated model formed by 11 key performance indicators for monitoring the performance, maintenance and cost effectiveness of hospital facilities. Building on this, Lavy and Shohet (2007) designed an Integrated Healthcare Facility Management Model established through an integrated analysis of key performance indicators which integrate the strategic and tactical decision making process on the life cycle perspective. Steinke *et al*., (2010) developed a building performance evaluation methodology by looking at healthcare facilities from the service, functional, physical and financial performance perspectives. Besides these studies, the authors believe that there is room for improvement and seek to offer a list of performance attributes and more practical set of indicators based on international best practices, relying on performance measurement and monitoring approaches that are currently in use.

METHODOLOGY

This research aims to provide a better understanding of the landscape of performance measurement in healthcare estates from a strategic perspective by reviewing and comparing the performance measurement and monitoring approaches adopted by nine public healthcare organisations to identify the similarities, differences and gaps. The review sought to compile an initial list of estate performance attributes and core KPIs that are practical and currently in use by international public healthcare organisations emerging from this comparison. The results presented from this first phase provide a point of departure for the second phase which seeks to widen the sample through a Pan EU survey of healthcare providers. The third phase will involve the design and hold of a series of workshops with experienced stakeholders and follow up interviews to establish the final framework that will be validated in the phase 4 with HFS and other organisations.

This research takes an exploratory approach to knowledge-building with a view to allowing the researchers to observe similarities and gather relevant data that will help shape the later phases. For this research, a review of the estates and facility performance management systems of nine healthcare organisations were examined to identify the performance measurement and monitoring approaches adopted, followed by the identification of the performance measures and KPIs within the approaches, and the subsequent analysis of the attributes of the estate they represent with a view to establish a list of common performance areas called 'attributes' for the purpose of this project.

Healthcare organisations were selected based on availability and access to information including: NHS in England, Scotland and Wales, Health and Human Services (HHS) in United States, Health Agency in New South Wales (Australia), Health Department in New Zealand, Queensland Health (Australia), the Spanish healthcare system and Province of Ontario (Canada). Qualitative data was collected through discussions and clarifications with key professionals drawn from HFS's network of international contacts; and an extensive grey literature search and review of government policies, guidelines, frameworks and strategies regarding asset and facility management and performance measurement.

Each document was evaluated to answer a set of questions that evolved during the initial stages of the research:

15. Has the organisation adopted any approach to measure and monitor the performance of the estates?
16. What characteristics of the estate are assessed and monitored, and what are the drivers?
17. What performance measures and KPIs are used?

In the study, the context of the performance measures and KPIs within and for each healthcare organisation was conducted with a view to understanding their strategies, funding, policy drivers, etc. The KPIs identified across the organisations were rationalised according to what they represented following the classification proposed by Lavy *et al*., (2010): financial, physical, functional and survey-based (in this context named 'patient experience'). Because not all of the groups fall under one of the four categories the authors added three more categories emerging from the analysis: 'safety', 'environment' and 'others'. Other categorisations could have been taken based on the domains observed in the performance measurement and monitoring frameworks; however, the authors considered this classification as the most appropriate as it is not influenced by the individual organisation' strategies and policies, appearing to be common to all healthcare providers. A total of 27 characteristics were obtained and sorted into the 7 overarching categories.

Data collected was presented in the form of excel spreadsheets to allow for comparisons and to identify the similarities and gaps. Each KPI was properly defined and their applicability analysed in the context of the country where they were used and reflective drivers. For this paper, this work was summarised and presented in a more compressed form.

The initial comparison was hampered by the lower than anticipated levels of transparency and participation from the healthcare organisations across the world. In addition, the lack of definitions and unclear terminology offered in the documents examined presented challenges in terms of comparison often limiting the potential for

analysis and requiring follow up interviews for clarification. The next phase of the research will explore means of widening the sample as well as expanding it beyond largely non-English speaking countries through a Pan EU survey with inclusion of other relevant international healthcare organisations.

FINDINGS AND DISCUSSION

The review shows that not all the healthcare organisations have adopted performance measurement systems based on KPIs such is the case of Spain, which limited the study to eight healthcare providers. It was also found that in the State of Queensland (Australia) currently there is not a common performance measurement framework. However, prior to the recent transfer of ownership to the District Health Boards the Australian Government required all Hospital and Health Services (HHSs) to spend at least 2.15% of their asset replacement value for the building maintenance, and to report it in conjunction with the planned versus corrective maintenance ratio and the unfunded backlog maintenance liability. At present, these KPIs are still being used by some of the Queensland HHSs and therefore are included for analysis in this research.

Performance characteristics and KPIs

The review reveals that there is not a single set of performance measures uniformly applied for the healthcare estate. Each organisation monitor their estate performance using a set of measures that are driven by individual government and healthcare organisational policies, strategies and goals, and this is influenced also by the shape of their estate portfolios. For instance, the performance measures adopted by NHS England in the Premises Assurance Model (PAM) address the challenges of funding in the future, and are aligned with the NHS Constitution regulatory requirements of ensuring ‘service users are protected against risks associated with unsafe and unsuitable premises'. NHS Scotland primarily focuses are the safety of the patient, to improve efficiency, the physical condition and the quality of the facilities, and reduce underutilise space.

In the case of New South Wales, the performance measures are underpinned to the Health Department's aim of delivering long term benefits through the improvement of the condition of assets, reducing future cost of management and maintenance, and having an estate portfolio aligned with service delivery requirements. In the United States, HHS has the long term goals of ensuring that property inventories are maintained at the right size, cost and condition to support agency missions and objectives. In the case of New Zealand the primary focus is on condition and utilisation as they enable for a more informed asset management practice, and also functionality with a view to providing better investment planning and decision making; or in New South Wales where there is a large interest on addressing poor asset condition and functionality, providing the right services in the right locations with facilities that support efficient and appropriate service provision.

Despite each organisation reflecting their own priorities, the review reveals that there are some similarities in the long term goals, mainly related to improving conditions, functionality, reducing costs and utilisation, with a list of attributes that are commonly assessed and monitored by the greatest number of organisations. These are physical condition, space utilisation, functionality (ability of facilities to support required functions) and measures within the financial perspective relating to operational cost, backlog maintenance (also called deferred maintenance) and maintenance cost. Other attributes identified tended to be only monitored by just one or a limited number of

organisations tending to be specific and reflective of the organisations' strategies, priorities and policies. An example of this would be the percentage of single bedrooms in NHS England which is viewed as an indicator of patient experience which is an important consideration for their patient centred delivery approach. In New South Wales (Australia) the effectiveness of maintenance programmes is assessed as it is viewed by policy makers as the way to achieve a more reliable operation of the assets and reduced incidence of premature failure requiring expensive repair or replacement, thus freeing funds for other purposes. In the United States the ratio of expenditure on maintenance and repair costs to the investment required is measured with a view to avoid shortfalls that are likely to reduce useful life of the facilities degrading the overall performance and causing an increment of long-term costs.

Although these measures have a more strategic focus, there is evidence in the literature for their assessment and monitoring. For example, measuring the effectiveness of maintenance programmes have been supported by Lavy *et al*., (2014); or Tucker and Smith (2008) who stated the need for monitoring patient experiences and customer satisfaction in order to understand the facility's performance from a user's perspective. In general, less attention is given to environmental indicators in the estate performance frameworks as it is normally reported in detail by different departments aligned with other policy priorities. Such as is the case of NHS Scotland who argues that there are very specific requirements for how environmental performance is measured due to its scale and complexity of monitoring. However, authors such as Lavy *et al*., (2014) and Brackertz (2003) included the environmental perspective as a core element for facilities assessment.

Table 2 reflects the similarities and differences among the organisations in terms of the attributes of the estate that each organisation considers in their performance measurement and monitoring frameworks; and table 3 offers a compilation of all the KPIs identified from the review for each attribute.

The following sections describe the performance attributes that are mostly monitored by the healthcare providers reviewed, and the literature opinion on the rational for their consideration.

Physical condition

Physical condition is considered by many authors as a core element for measuring and monitoring estate performance (Lavy *et al*., 2014; Syakima *et al*., 2011). It supports the decision makers to decide whether to continue using or to maintain the assets, to repair deficiencies or even proceed to disposal. Different approaches are used by organisations to assess physical condition, such as to measure it on a scale of good, fair or poor and unsatisfactory (or similar) as it has been proposed by some authors in academia; or through the use of the Facility Condition Index, a standard metric used widely to report physical condition by both organisations and advocated in the literature; although authors such as Lavy *et al*., (2014) employs this indicator to report maintenance efficiency.

Space utilisation

During the last two decades emphasis has been given by many authors for the assessment of space utilisation in facilities. Douglas (1994) listed space utility (identifying under-used and over-used spaces) among ten primary measures for effective evaluation of facility's performance. Wauters (2005) stated that benchmark space use is a prime aspect in facilities management as it drives all the premises costs.

Table 2: List of estate attributes considered by each organisation

	Attributes \ Organisations	NHS England	NHS Scotland	NHS Wales	HHS United States	New Zealand	New South Wales (Australia)	Ontario (Canada)	Metro North HHS (Queensland)
Financial	Operational cost	■	■		■	■	■		
	Maintenance cost	■	■		■	■	■		
	Backlog maintenance cost	■	■	■	■				■
	Resource allocation				■				■
	Productivity	■							
Physical	Physical condition		■	■	■	■	■	■	
	Age	■	■	■					
	Remaining economic live					■			
Safety	Statutory compliance	■	■	■					
	Level of risk associated with outstanding backlog maintenance	■	■	■					
	Fire incidents	■							
Functional	Utilisation	■	■	■	■	■	■		
	Surplus					■			
	Available capacity					■			
	Functionality/Functional suitability	■	■	■		■	■		
Patient Experience	Quality of the building		■						
	Single bedrooms	■							
	Patient feedback	■	■						
Environment	Energy performance	■		■					
	Water and Waste	■							
	Sustainability				■				
Others	PAMS*Quality		■						
	Organisation Governance	■							
	Daily decision metrics				■				
	Construction programme metrics				■				
	Effectiveness of maintenance programmes						■		■
	Mission Dependency				■				

*Property Asset Management Strategy (PAMS)

For instance, in Australia the HHS identified savings and cost avoidance of over $23 million between 2010 and 2012 through improved utilisation, the associated energy savings, as well as disposal and consolidations (Holland, 2013). Most of the organisations reviewed are working towards the improvement of space utilisation as a means of cost-savings, but it is also a measure to determine whether additional expenditure is likely to meet demand effectively or create surplus stock. How space

utilisation is measured varies among organisations. Different measures are identified through the review, including the required program space vs. the existing space, referred by Lavy *et al*., (2014) as a functional index; but also the percentage of space utilised assessed as proposed by Douglas (1994).

Table 3: List of attributes and KPIs considered by healthcare organisations to evaluate estate performance

Dominions	*Attributes*	*Key Performance Indicators*
Financial	Operational cost (all per sq.m.)	Annual operation cost; Total operating cost; Cleaning cost; Rates cost; Catering cost; Pottering cost per consumer week; Laundry and linen cost per consumer week; Energy cost; Waste cost per consumer week; Facilities management cost; Cost efficiency score
	Maintenance cost	Maintenance cost per sq.m; Total maintenance expenditure by functional area
	Backlog maintenance cost	Backlog maintenance cost per sq.m.; Total maintenance backlog cost/ gross internal area (GIA)
	Resource allocation	Annual Maintenance expenditure as a %Total Replacement Value; Sustain Rate
	Productivity	Adjust Treatment Index (ATI)
Physical	Physical condition	Percentage of the estate to be in excellent or satisfactory condition with evidence of only minor deterioration or above; Facility Condition Index (FCI) or Condition Index (CI); Physical Condition Index
	Age	Percentage of properties less than 50 years old; Percentage of the estate built since 1948; Average age
	Remaining economic live	No KPIs identified
Safety	Statutory compliance	Overall percentage compliance score from SCART*; % of the estate that is required to take action in the current plan period to comply with relevant guidance and statutory requirements
	Level of risk associated with outstanding backlog maintenance	Significant and high risk backlog maintenance as percentage of total backlog expenditure requirement; Total risk adjusted backlog maintenance
	Fire incidents	Number of unwanted (false) fire incident calls/GIA; Number of fire incidents/GIA
Functional	Utilisation	Space utilisation (percentage of properties categorised as fully utilised; building area sq.m per consumer week; % of occupied floor area; percentage of space utilisation; required program space vs. the existing space); Utilisation Index; Usage (Total replacement value/weighted separation; Weighted separation per sq.m.; Asset depreciation/ weighted output measure of service)
	Surplus	No KPIs identified
	Available Capacity	Beds per 1,000 people; Theatres per 10,000 people
	Functional Suitability	Percentage of properties classified as ideal accommodation or very satisfactory; Functional unsuitability (%of occupied floor); Functional Performance Index
Patient Experience	Quality of the building	Percentage of properties categorised as excellent or satisfactory quality in terms of amenity, comfort engineering and design
	Single bedrooms	Percentage of single bedrooms for patients
	Patient feedback	Positive response to patient questionnaire on patient rating of hospital environment; Percentage of positive response for privacy and dignity; Percentage of positive response for cleanness and tidiness; Percentage for positive response for food services
Environment	Energy performance	Total site energy consumed /Heated; Net energy consumption; Carbon Dioxide Emissions/ Occupied floor area; % of the estate with an energy consumption of 410KWh/m2 or less
	Water and waste	Water, sewage and waste carbon indicator
	Sustainability	Sustainability Index (SI)
Others	Property Asset Management Strategy (PAMS) document Quality. KPI: PAMS Quality checklist overall score Organisation governance – No KPIs identified Daily decision metrics Construction programme metrics Effectiveness of the Maintenance Programmes. KPIs: Ratio of Programmed Maintenance to Reactive Maintenance; Backlog maintenance as a % programme maintenance; Total maintenance expenditure/ weighted of separation Mission Dependency – No KPIs identified	

* Statutory Compliance Audit and Risk Tool (SCART)

Functionality

Functionality is the extent to how well the available accommodation supports the delivery of healthcare. To measure and monitor facilities functionality has been recommended by a few authors in academia (Brackertz, 2004; Syakima *et al*., 2011) and some standard bodies such as Australian National Audit Office (2010) that

includes the functionality dimension to evaluate how the asset assists in meeting its program delivery requirements. In healthcare, monitor functionality is highly important due to the advances in the technology and changes in disease trends. In New Zealand functionality is monitored with the intention of supporting the change in the models of care and health services requirements. What elements are considered for assessing functionality vary slightly among organisations and the proposed by some authors. NHS Scotland assesses functional suitability according to three elements, including internal space relationship, support facilities and location in terms of how space is situated in relation to other departments. A similar approach is taken by NSW that assesses functionality in terms of internal fit-out capability, the capacity of the facility, the location and the relative level of amenities required to ensure the efficiency of the operation. Lavy *et al*., (2014) proposed to assess functionality looking at organisational or business mission, space, employees and other support facilities. Talib *et al*., (2013) evaluated functionality in terms of the design, utility and access.

Operation cost, maintenance cost and backlog maintenance cost
Financial measures are important as they provide the current expenses in the facility or organisation. The KPIs used by organisations vary from those proposed by some authors. Most of the organisations measure and monitor backlog maintenance cost as backlog cots /m2, whereas some authors focus more in the efficiency of the maintenance programmes, such as Lavy *et al*., (2014) that use the maintenance efficiency indicator (MEI) that is the ratio of spending percentage on deferred maintenance (SDM) to the Current Value. This has been considered as the most influential performance indicator that could significantly affect the strategic decision making in an organisation (Lavy *et al*., 2014).

CONCLUSION

Similarities are observed in the performance attributes and KPIs considered by and among healthcare providers for estate performance measurement and monitoring which are common to most providers, such as physical condition, utilisation, functionality, operation cost, backlog maintenance and maintenance cost; but also variations, as some of the measures that are meaningful for some organisations are not for others, driven by government priorities, policies, organisations goals. The review also shows that there are some differences in the set of core attributes and KPIs established by authors in the literature, and the elements for assessment.

This research asks whether it is possible to establish a common framework representing a core set of attributes and KPIs to be used for strategic management and planning for healthcare estates which can encourage healthcare organisations to align with international best practice. Despite the potential theoretical contribution offered, there is a need to explore the value of its application, as there is no single, best set performance measures suitable for every healthcare provider. Each of the healthcare providers monitor and develop its own set of measures based on its organisational structure, goals and with consideration of the data already in place. However, the authors believe that there is a set of core attributes that should be measured and monitored by all the healthcare providers to obtain the best value of the estate relying on international best practices.

REFERENCES

Amaratunga, D and Baldry, D (2002) Moving from performance measurement to performance management. *Facilities*, **20**(5/6), 217-223.

Australian National Audit Office (ANAO) (2010) Strategic and Operational Management of Assets by Public Sector Entities: Delivering agreed outcomes through an efficient and optimal asset base.

Bassioni, H A, Price, A D F and Hassan, T M (2004) Performance measurement in construction. *Journal of Management in Engineering*, 20(2), 42-50.

Brackertz, N (2004) A framework for the strategic management of facilities, balancing physical and financial considerations with service, customer, utilisation and environmental requirements. *In*: *10th Pacific Rim Real Estate Conference: International Property Investment, 25-28 January 2004, Windsor Suite Hotel, Bangkok, Thailand*.

Douglas, J (1994) Developments in appraising the total performance of buildings. *Structural Survey*, **12**(6), 10-15.

Fitzgerald, L, Johnston, R, Brignall, S, Silvestro, R and Voss, C (1991) *Performance Measurement in Service Businesses; CIMA Research Series*. Cambridge: Black Bear Press Ltd.

Hinks, J and McNay, P (1999) The creation of a management-by-variance tool for facilities management performance assessment Facilities, **17**(1/2), 31-53.

Holland, E J (2013) *Saving Taxpayer Dollars: Freezing the Federal Real Estate Footprint*. U.S Department of Health and Human Services (Testimony)

Lavy, S, A Garcia, J and K Dixit, M (2014) KPIs for facility's performance assessment, Part II: identification of variables and deriving expressions for core indicators. *Facilities*, **32**(5/6), 275-294.

Lavy, S, Garcia, J A and Dixit, M K (2010) Establishment of KPIs for facility performance measurement: Review of literature. *Facilities*, **28**(9/10), 440-464.

Lavy, S and Shohet, I M (2007) A strategic integrated healthcare facility management model. *International Journal of Strategic Property Management*, **11**(3), 125-142.

Meng, X and Minogue, M (2011) Performance measurement models in facility management: A comparative study. *Facilities*, **29**(11/12), 472-484.

Pullen, S, Atkinson, D and Tucker, S (2000) Improvements in benchmarking the asset management of medical facilities. *In*: *Proceedings of the International Symposium on Facilities Management and Maintenance*, Brisbane, Australia, 265-71.

Purbey, S, Mukherjee, K and Bhar, C (2007) Performance measurement system for healthcare processes. *International Journal of Productivity and Performance Management*, **56**(3), 241-251.

Shohet, I M (2006) Key performance indicators for strategic healthcare facilities maintenance *Journal of Construction Engineering and Management*, **132**(4), 345-352.

Shohet, I M (2010) Community Clinics. *In*: M Kagioglou and P Tzortzopoulos (Eds.) *Improving Healthcare through Built Environment Infrastructure*. Oxford, UK: Wiley-Blackwell, 249-266. doi: 10.1002/9781444319675

Steinke, C, Webster, L and Fontaine, M (2010) Evaluating building performance in healthcare facilities: an organizational perspective HERD: Health Environments. *Research & Design Journal*, **3**(2), 63-83.

Syakima, N, Sapri, M, and Shahril, M (2011). Measuring performance for classroom facilities. *International Conference on Sociality and Economics Development*, **10**, 209-213.

Talib, Y, Yang, R J and Rajagopalan, P (2013) Evaluation of building performance for strategic facilities management in healthcare: A case study of a public hospital in Australia. *Facilities*, **31**(13/14), 681-701.

Tucker, M and Smith, A (2008) User perceptions in workplace productivity and strategic FM delivery. *Facilities*, **26**(5/6), 196-212.

Wauters, B (2005) The added value of facilities management: Benchmarking work processes. *Facilities*, **23**(3/4), 142-151.

EVALUATING THE ABILITY OF BIM TO ENHANCE VALUE IN FACILITIES INFORMATION MANAGEMENT

Christaline Wijekoon[1], Anupa Manewa[2], Andrew Ross[3] and Colin Davies[4]

[12&3] *Department of the Built Environment, Liverpool John Moores University, Byrom Street, Liverpool, L3 3AF, UK*

[4] *Liverpool John Moores University, 70 Mount Pleasant, Liverpool, L3 5UA, UK*

The concern towards information management in construction industry has been changed over the past decade with the introduction of Building Information Modelling (BIM). With this influence the Government Soft Landing Policy focuses on early end user engagement to enhance the in-use performance of buildings. Literature reveals number of advantages that BIM promises on enhancing the efficient management of buildings. However, many of these findings explain what BIM can do and only limited effort has been taken to reveal the mechanism to exploit those good practices. This knowledge gap has slowed down the adoption of BIM beyond government projects. The success of BIM is based on information it holds. Hence this paper attempts to investigate the value of construction information to the facilities management to understand optimum level of information to be handed over through BIM. Also, it further attempts to explain how BIM can be used as a vehicle to improve such value. 14 interviews were conducted among construction professionals to gather the value perception of information. The qualitative data were analysed through thematic analysis based on grounded theory. The information value matrix was developed to assist facilities managers on understanding information requirement and value of information.

Keywords: Building Information Modelling, facilities management, value of information

INTRODUCTION

Construction industry is forecasted to have a 70% economic growth by 2030 (HM Government 2013). Building Information Modelling (BIM) is one of the key concepts pioneered by the UK Government towards achieving this growth in construction sector. As a result, BIM is considered as a mandatory requirement in every centrally procured construction project (HM Government 2013). A growing interest for adopting BIM technologies within construction products and processes is visible (NBS 2015). The literature emphasise the fascinating contribution of BIM from design and construction to operation and maintenance stages of a built asset (Eadie *et al.*, 2013, Volk *et al.*, 2014, Giel and Issa 2016). BIM improves collaboration, visualization, waste reduction and many similar aspects engaged with process improvement (Eadie *et al.*, 2013).

[1] christalinewijekoon@gmail.com

Wijekoon, C, Manewa, A, Ross, A and Davies, C (2016) Evaluating the Ability of BIM to Enhance Value in Facilities Information Management. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1225-1234.

A frequent application of BIM in design and construction phases of product lifecycle can be identified (Becerik-Gerber *et al.* 2012) leaving facilities management isolated. Research on this matter noted that lack of experience in BIM as a key barrier for implementing BIM beyond design and construction (Eadie *et al.*, 2013, Giel and Issa 2016). However, this leads only to the reason for the problem. Yet, the question is still remains unanswered.

BIM can be explained based on its two main features of physical modelling of a 3D model and capability on capturing and storing information in text, numeric and graphical forms (Chen *et al.*, 2015). Importantly the information richness of BIM model is what makes it outstanding from any other 3D modelling tool (Demian and Walters 2014). It is capable of handling high volume of information at any given time, however it is necessary to understand the level of information which is economical for an organization.

Taking lead from the literature findings, this paper attempts to identify the barriers of adopting BIM in facilities management and also to cluster the information based on their perceived values. Having said that, the paper identifies information needs in facilities management as the starting point and then look forward to the mechanisms for value additions.

Facilities information management

Facilities Management (FM) is managing the complexities of a built facility to conduct a smooth functioning including its physical structure and support services (Kincaid 1994) to enhance the core business performance. The information used for FM purposes can be broadly categorise into 3 namely; construction information, business information and building operation information. In general, construction information refers to the information which are generated during design and construction of a facility (Craig and Sommerville 2006). However, construction information in FM's perspective is the information which are produced to building owner/facility manager by the project manager at the project handover (Clayton *et al.*, 1999) which includes the as-built information and exclude large amount of other construction information such as design variations, clash detections. Construction information are generated by number of project stakeholders who are having different level of interests and influence towards the project targets (see Figure 1). These information takes a complex flow due to the fragmented nature of the construction industry (Bouchlaghem *et al.*, 2004).

Types of facilities management information and their inbound complexities in terms of information flows are identified in Figure 1. Facilities management information needs are being fulfilled by 3 main types of information. Construction information which are generated at the design and construction stages of the building aims to educate facilities management team about the asset information, space allocations and maintenance requirements. It has a complex information flow due to multiple stakeholder involvement at construction stage. Comparatively the other two types of information used for facilities management have a direct flow as they are being generated during operation and maintenance of the building on which facilities manager have much control over. Business/market based information focuses on any information that supports to run the business smoothly such as functions carried out in the facility, expected occupancy rates and other business functional information which matters to the facility operations.

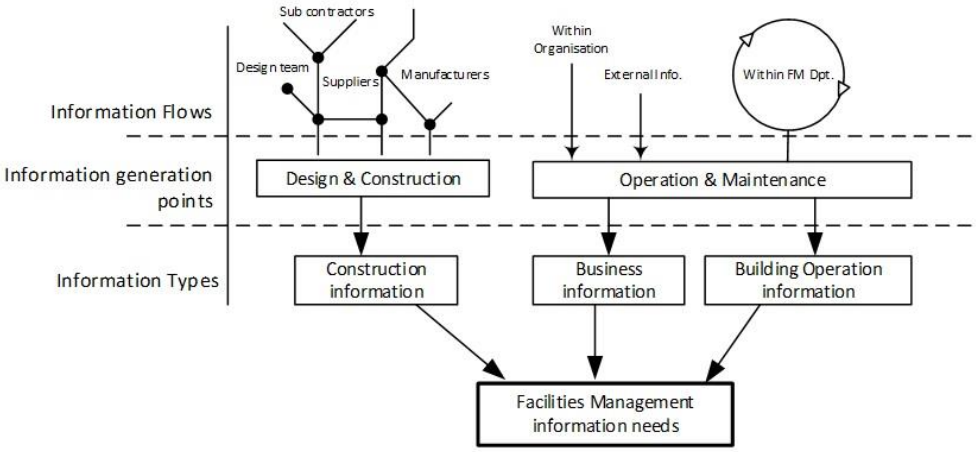


Figure 1: Facilities information flow

Usually, these information fed into the FM division from other departments in the organisation (Chotipanich 2004) and the right information at right time is the key to success at this point. Final set gathers information about the facility operation details such as energy consumption, maintenance records, facility operation staff information and such other information directly related to the building operations (Whitaker 1995). Whitaker (1995) further noted this is one of the responsibilities vested upon the facility manager and they are created within the FM division.

It is evident that information required for a smooth FM is scattered throughout the building life cycle. Although a must needed early engagement of a facilities manager is recommended in the theory, it is not common in the practice (Eastman 2011). Due to late involvement of a facility manager and complexities in construction information flows create several difficulties for facilities managers in acquiring construction information (Clayton *et al.*, 1999, Anderson *et al.*, 2012, Wang *et al.*, 2013). Therefore, most critical and frequent facility information management issues are based on construction information (Clayton *et al.*, 1999, Bröchner 2008).

On the other hand BIM is a process initiating building information management from early stages of a built facility has become a partial solution to the problems faced in design and construction in related to gathering information from number of stakeholders (Grilo and Jardim-Goncalves 2010). It carries a greater potential in information management during facilities management (Giel and Issa 2016). However, the potential benefits of BIM in facilities management is frequently gained through the information availability at the facility handover (Anderson *et al.*, 2012). Therefore it is necessary to identify facilities management information requirements at the early stages of a built facility. Due to the large number of information generated during design and construction and variety of needs in building operation and maintenance, it is necessary to accompany a filtering mechanism to recognise the information with an economical consideration. In this regard, identifying value of information is considered as an accepted concept to identify most important information (Neal and Strauss 2008).

Information value

The term 'value' is multifaceted and provides different meanings to different stakeholders. Simply it’s the 'cost' over 'benefits', which represents the worth of the considered matter (Neal and Strauss 2008). The costs and benefits can be communicated in different ways. Repo (1986) explains a dual approach as "exchange

value" and "value in use". Exchange value refers to market value of information when it is regarded as a product or service. On the other hand value-in-use refers to the benefits of information to the users which is not always in monetary terms.

However, the elements associated of each variable (objective or subjective) and the level of influence will differ based on the project. In construction, a balance of cost, quality and time is considered as a method to ascertain value (Best and De Valence 1999). Although the research is set in the Architecture, Construction, Engineering and Facilities Management (AEC/FM) setting, it is necessary to look for the features related to information to define the value of information beyond project's success.

Allocation of a monetary value to a piece of information is almost impractical (Gallagher 1974). Working on the cost benefit equation to capture the value of information, Gavirneni *et al.*, (1999) developed an equation based on case studies in supply chain information flow. They compare the monetary, performance and lead time improvements made through availability of information. Similarly, by elaborating factors considered as benefits in value equation Neal and Strauss (2008) introduced a measurement tool to capture the brand value. Both of the methods being successful attempts due to the uniform nature of the manufacturing industry and its products. Conversely, this same reason makes them weaker to apply in construction industry. However, there are key points which can be taken forward to capture value of construction information for facility management.

One such fact which can be taken from manufacturing industry is that comparing the two situations of performing a task with and without information (Gavirneni *et al.*, 1999). Consequently, the improvements made through the situation when information is available quantify the value addition done through it. Value is something more "adjectival rather substantive" therefore, it should be found with along the considered object and interest (Perry 1914). On the other hand, Gallagher (1974) suggested 3 possible ways to measure the value of information. The first and the best way according to Gallagher is measuring the value after the information is being used and the consequences of the action are known. By obtaining the positive features of many value measurements the definition for the value of construction information for facilities management is defined as practical consequences result by information. Therefore, the value-in-use is considered as its concerns fit with the characteristics of facilities management information. As a result, this will attempt to understand the uses of information in FM.

RESEARCH METHOD

Literature review was undertaken to identify the facilities management information needs and also to establish the information value. A qualitative approach was adopted due to lack of available knowledge related to facilities information and its value. Accordingly, 14 semi structured interviews were conducted among construction industry professionals (5 facility managers, 2 estate managers, 2 contractors, 2 architects, surveyor, BIM manager and a CAFM service provider). Data was collected from different roles engaged in facilities information requirement identification process to have a holistic idea about the situation. However, priority was given to information demand side (5 facilities managers and 2 estate managers).The key purpose of these interviews was to identify the information requirements and flows (in and out) during the facilities management stage and further to explore how different stakeholders with different interests recognise 'value' of information. Data were analysed through coding (open coding, axial and selective

coding) and fed into the information value matrix. This matrix is in its development stage and needs to be tested for its usability and validity.

DATA COLLECTION AND ANALYSIS

The questionnaire focuses on three main themes, which can be clustered under 'current facilities information management practices and issues', 'information value' and capability of BIM in providing such value'.

The data were analysed thematically by adopting the systematic approach (open coding, axial coding and selective coding) coming under grounded theory research methodology. Interview transcripts were analysed for the first time with an open mind to identify the themes discussed by the interviewees. Then categories were made grouping similar themes together. At the second step (Axial Coding) properties and dimensions of categories were defined to have a more solid idea about the themes generating within data. This was done by going through the interview transcripts once more looking specifically towards the frequently raised points. Figure 2 illustrates the key findings generated through open and axial coding processes.

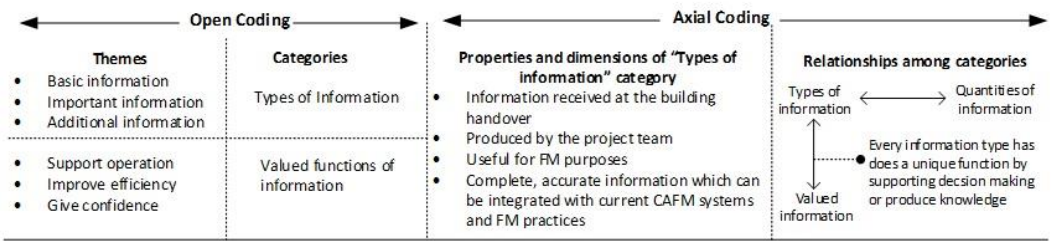


Figure 2: Open and Axial Coding

As shown in Figure 2, during Open Coding a category of "Types of Information" was developed based on the 3 similar themes generated within data. Accordingly, types of information consist of basic information which are highly necessary for building operation, decision making and compliance. During Axial Coding, properties and dimensions of this category were defined based on responses such as *"the lead contractor is liable to provide necessary documents in softcopies at the handover"* which was stated by a facilities manager. The given quotation emphasise a dimension of the "types of information" category through the code *"at the handover"* by limiting the amount of information falls under the category. A property of the category was derived from a surveyor's statement *"not all information is accurate most of the time"* which made the point that information should be accurate to perceive its value. Once the categories were formed their relationship with each other is considered during Axial Coding. For example, "types of information" was related with "quantity of information" as well as "uses of information". The final step of the analysis is Selective Coding which is dedicated to study the relationships among categories and to understand the concept developed within data. Accordingly, "information" was selected as the core category and its relationship to other categories was formed to explain the developed concept. The findings of data analysis were used to develop the Facilities Information Value Matrix (see Figure 3).

RESULTS AND DISCUSSION

A clear link between value and information is noted as a core result. In a broader perspective information is to be valuable in anyway and because of this understanding information users preferred to have more information having believed that value

increases with the amount of information on hand. This positive relationship between value and information has resulted asking for "all the information" about the built asset from the project team. However, information users have no clear idea about what information will be available in a complete BIM model with all the information or how to make use out of most of information. Although this is the preference of majority of facility managers none of them acquire such complete information pool to study its impact. This confirms that owners and facilities managers does not have adequate knowledge and experience to gain the benefits of BIM (Giel and Issa 2016).

The uses of information were identified base on the available information on site for facility management. This revealed that construction information is being used to answer two main questions. At the very beginning of the building operations, construction information assists to understand the facility including the background details, features and potential capabilities of a particular facility such as occupancy capacity, weatherproof qualities, heat load etc. Secondly it guides the user on how to operate the facility including the equipment handling, maintenance requirements and possible precautions to be taken for any failure. Facility managers value this contribution of the construction information and cluster information to gain value through different functions. Accordingly, construction information is clustered into 3 namely; basic information, important information and additional information. On the other hand, 3 value levels (Operation, Efficient and confidence) on construction information were identified through the interviews. The value levels were judged based on the functions fulfilled by construction information. As a result, Facilities information value matrix was develop by plotting the relationship between value functions and information along with the value perceived at each combination (Figure 3).

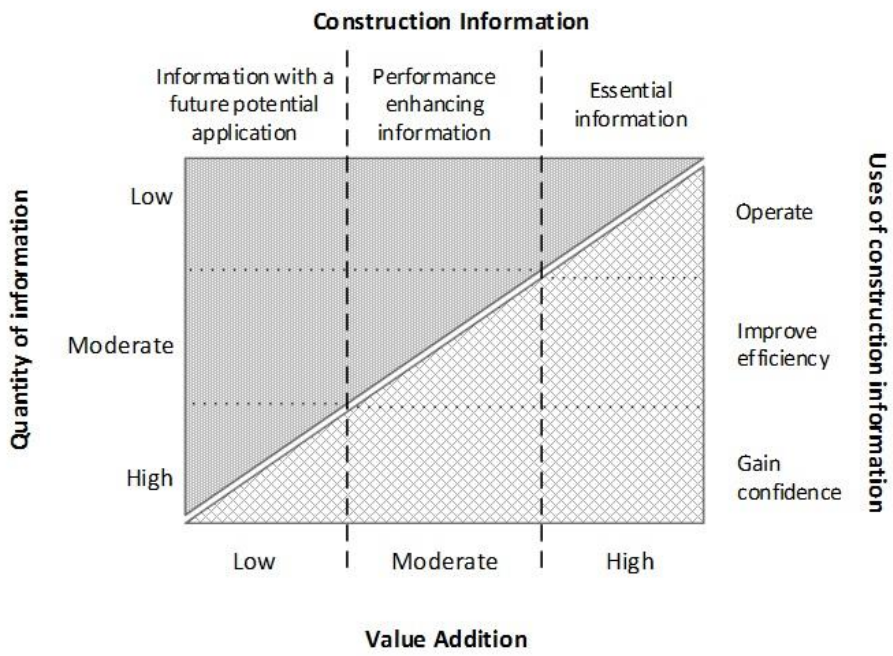


Figure 3: Facilities Information Value Matrix

Value matrix measures the uses of construction information (operate to confidence built up), types of information (essential to future potential), quality (low to high) and value addition of information (low to high). For example, the highest value addition of construction information is done through supporting the operations of a building to

the required standards. This use of information can be achieved by having essential set of information which includes drawings, safety manuals and other information which are necessary to gain approval and maintain compliance requirements. Value matrix graphically indicates this relationship showing the essential information which contains the least amount of information brings in the highest value addition. Accordingly, these information is used to operate, improve efficiency and also bring confidence to the information users by knowing the most critical facts about the building. Essential information are the minimum level of information required for facility management and this will ensure that services will be available and building is live for the business. However, this level is more towards adhering to the statutory requirements.

Stepping ahead from the minimum operational level, information has the capability to bring efficient performance. It is the second use of information on the value matrix. In order to perform FM tasks efficiently, it requires some important information along with the basic operational information. This additional set of performance enhancement information such as energy performance of the building, location of the assets will avoid extra time and effort spent on facilities management tasks. For example; if a technician can refer to the information and identify the type of bulb in the room which the maintenance request was made on, then he could take a suitable bulb and necessary equipment to fix it at one go rather physically examining for all these details and going back to stores to collect necessary equipment. Likewise, having performance enhancement information brings value through efficiency.

Finally, information gives confidence. Facility managers do prefer to have more information although they do not fully use them to sustain their businesses. They demand for this preference to gain confidence by knowing all information about the facility. To a certain level, availability of additional information directs to identify unrevealed applications of the information to the current system and to make them efficient. However, at the moment of request of these additional information they would not provide any efficiency or support the operational tasks but brings a psychological comfort by giving confidence of knowing.

After identifying the relationship between information and their uses, a hierarchy of preference was revealed. This is indicated through “Value addition” on value matrix. Value addition shades presents the worth of each use of information. On the other hand, information quantity on value matrix represents the quantity of information embedded on each type of construction information. Accordingly, “essential information” category has the least quantity of information while “future potential information” category carries the highest amount of information.

Among the uses of information, facilities managers retain most value by having building operated with a zero down time. They tend to make every possible effort to gather information which supports the operation. Next, they value the information which helps to improve the efficiency and finally the confidence. Therefore, value addition done through information match with diminishing marginal utility theory. On the other hand, it can be said that majority of the information in a fully complete BIM model is additional information which brings the least value addition by merely giving confidence to the users. Therefore it is important to filter the necessary information to capture more basic and important information which will ultimately create a highly valued information base.

In a nutshell, the preference to have all the information proven to be an inefficient choice. Identifying value of information through different functions brought into the decision that not every information is necessary specially when considered with the cost of information management (acquire, store, retrieve, update, use). Although the cost of information was not considered within this paper, it was evident that value decisions were made based on some kind of cost parameter although it was not in monetary terms at all times.

CONCLUSION AND RECOMMENDATIONS

Building Information Modelling (BIM) is an emerging topic in construction industry. It is worth the attention BIM has gained with the tremendous input it brings into the industry to move forward with the others and to be equipped to match with the digital economy dilemma under current circumstances. More importantly, BIM process does not limit itself to a specific task or a stage in the building but addresses the whole life cycle with a positive impact. Although current BIM practices are dominant in design and construction phases of a built asset, it was found that owners and facilities managers benefit the most out of BIM with its lifelong application (Eadie *et al.*, 2013). Contradictorily a reluctance in adopting BIM among facility managers is noted confirming the previous research findings (Giel and Issa 2016).

The key benefit of BIM for Facility Management (FM) is the opportunity of acquiring as-built information for building operation and maintenance. The long term application of BIM in FM highly depends on the information passed through BIM process. Therefore, it is necessary to identify facility management information requirements and communicate them to the project team beforehand. However, since information is always beneficial information users tempts to request for more information believing on the possible benefits they could bring. This unconscious decision may lead to information overloading, inaccurate information and missed opportunities to make optimum use of BIM by having a lighter BIM model.

Facilities information value matrix is in its conceptual phase, aims to provide a solution to this matter. Expanding its capabilities as a decision making tool, facilities value matrix has identified the expected value addition made at every option and the quantity of information represented by each information category in a hypothesised complete BIM project. With this facility managers can value their information systems by identifying the available information on their own systems and tracing them on the information categories in the value matrix. The result will guide the practitioners to make decisions on what information to be stored on BIM model for long term purposes and how to make use of available information. Also, use of this guiding tool will safeguard the client from losing essential information about the facility. Its application does not limit only to the information users but also brings knowledge to the information suppliers about the value addition done through their information in long term. This will promote accuracy and completeness of information handed over by the suppliers. In conclusion, value matrix promotes a decision making process based on the business opportunity created through facilities information and BIM rather gathering information based on the capabilities of information systems. However, the cost criterion should be considered to make informed decision on the information requirements and this will focus in future research.

REFERENCES

Anderson, A, Marsters, A, Dossick, C and Neff, G (2012) Construction to operations exchange: Challenges of implementing COBie and BIM in a large owner organization. *Construction Research Congress*, May 2012, 688-697.

Becerik-Gerber, B, Jazizadeh, F, Li, N and Calis, G (2012) Application areas and data requirements for BIM-enabled facilities management. *Journal of Construction Engineering and Management*, **138**(3), 431-442.

Best, R and De Valence, G (1999) *Building in Value: Pre-Design Issues*. London: Routledge.

Bouchlaghem, D, Kimmance, A G and Anumba, C J (2004) Integrating product and process information in the construction sector. *Industrial Management & Data Systems*, **104**(3), 218-233.

Bröchner, J (2008) Construction contractors integrating into facilities management. *Facilities*, **26**(1/2), 6-15.

Chen, K, Lu, W, Peng, Y, Rowlinson, S and Huang, G Q (2015) Bridging BIM and building: From a literature review to an integrated conceptual framework. *International Journal of Project Management*, **33**(6), 1405-1416.

Chotipanich, S (2004) Positioning facility management. *Facilities*, **22**(13/14), 364-372.

Craig, N and Sommerville, J (2006) Information management systems on construction projects: Case reviews. *Records Management Journal*, **16**(3), 131-148.

Demian, P and Walters, D (2014) The advantages of information management through Building Information Modelling. *Construction Management and Economics*, **32**(12), 1153-1165.

Eadie, R, Browne, M, Odeyinka, H, McKeown, C and McNiff, S (2013) BIM implementation throughout the UK construction project lifecycle: An analysis. *Automation in Construction*, **36**, 145-151.

Eastman, C M (2011) *BIM Handbook: A Guide to Building Information Modeling For Owners, Managers, Designers, Engineers and Contractors 2nd Edition*. Hoboken, NJ: Wiley.

Gallagher, C A (1974) Perceptions of the value of a management information system. *Academy of Management Journal*, **17**(1), 46-55.

Gavirneni, S, Kapuscinski, R and Tayur, S (1999) Value of information in capacitated supply chains. *Management Science*, **45**(1), 16-24.

Giel, B and Issa, R R A (2016) Framework for evaluating the BIM competencies of facility owners. *Journal of Management in Engineering*, **32**(1).

Grilo, A and Jardim-Goncalves, R (2010) Value proposition on interoperability of BIM and collaborative working environments. *Automation in Construction*, **19**(5), 522-530.

HM Government (2013) Construction 2025: Industrial Strategy for Construction London: Crown.

Kincaid, D (1994) Integrated facility management, *Facilities*, **12**(8), 20-23.

Knight, A and Ruddock, L (2008) *Advanced Research Methods in the Built Environment*. Chichester: West Sussex: Wiley.

Kvale, S and Brinkmann, S (2009) *Interviews: Learning the Craft of Qualitative Research Interviewing 2nd Edition*. London: Sage Publications.

NBS (2015) *National BIM Report*. London: RIBA Enterprises Ltd.

Neal, W and Strauss, R (2008) A framework for measuring and managing brand equity. *Marketing Research*, **20**(2), 6-12.

Perry, R B (1914) The definition of value. *Journal of Philosophy, Psychology and Scientific Method*, **11** (1914), 141-162. Available: http://search.ebscohost.com/login.aspx?direct=true&db=edsjsr&AN=edsjsr.10.2307.2013053&site=eds-live [accessed 11/02/2016].

Silverman, D (2013) *Doing Qualitative Research Fourth Edition*. London: SAGA Publication.

Volk, R, Stengel, J and Schultmann, F (2014) Building Information Modeling (BIM) for existing buildings: Literature review and future needs. *Automation in Construction*, **38**(1), 109-127.

Wang, Y, Wang, X, Wang, J, Yung, P and Jun, G (2013) Engagement of facilities management in design stage through BIM: framework and a case study. *Advances in Civil Engineering*, Article ID 189105. doi:10.1155/2013/189105.

Whitaker, M J (1995) Conducting a facility management audit. *Facilities*, **13**(6), 6-12.

A SOFT SYSTEMS METHODOLOGY APPROACH TO THE IMPROVEMENT OF A HOUSING ASSOCIATION'S DEFECTS MANAGEMENT AND LEARNING SYSTEMS

Tony Hopkin[1], Shu-Ling Lu[2], Phil Rogers[3] and Martin Sexton[4]

[1&3] NHBC, NHBC House, Davy Avenue, Knowlhill, Milton Keynes, MK5 8FP, UK

[2&4] School of Construction Management and Engineering, University of Reading, Whiteknights, PO Box 217, Reading, Berkshire, RG6 6AH, UK

Rapid growth in the production of new homes in the United Kingdom (UK) is putting build quality under pressure as evidenced by rising numbers of defects. Housing Associations (HAs) contribute approximately 20% to the UK's housing supply. HAs are experiencing challenges of central government funding cuts and rental revenue reductions. Maximising the benefit of learning from defects is recognised as being a key opportunity for HAs to help meet these challenges. This paper explores how a HA is introducing change to improve the way they learn from past defects in an effort to reduce the prevalence of defects in future new homes. Soft systems methodology was used to assist a HA who were intent on making such change, but were unable to identify a clear improvement opportunity. The findings identify a significant mismatch between what the HA's system should be doing to enable the HA to manage and learn from defects and the current situation. The mismatch has revealed to the HA that a modification to their information system is necessary to improve performance and enhance learning via live data analysis and reporting. This research is ongoing and the HA is currently in the 'taking action' stage.

Keywords: defects, housing associations, new-build housing, soft systems methodology

INTRODUCTION

In the UK there is a shortage of homes (Holmans, 2013). In order to reduce the shortage of homes, the UK house building sector is rapidly upscaling production, with a 16% increase in new housing completions for 2015 compared to 2013 volumes (HM Government, 2015). The current upsurge in housing completions is impacting build quality as evidenced by an increase in new housing defects. The Home Builders Federation survey (HBF, 2016) shows that in 2016, 62% of home owners reported over five defects in their new-build house, an increase of 3% compared to 2015.

Housing associations (HAs) contributed circa 20% of the UK's housing supply in 2014 (HM Government, 2015). Despite the HAs' important housing contribution, in recent years they have experienced declining funding from the UK Government (Jefferys *et al.*, 2014) and as of April 2016 were also required to reduce social housing rents by 1% each year until 2020 (HM Treasury, 2015). HAs remain committed to helping ease the UK's housing shortage but fear that the funding and rental reductions

[1] t.j.hopkin@pgr.reading.ac.uk

Hopkin, T, Lu, S-L, Rogers, P and Sexton, M (2016) A Soft Systems Methodology Approach to the Improvement of a Housing Association's Defects Management and Learning Systems. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1235-1244.

will limit their ability to develop new homes (NHF, 2015). Therefore, HAs are seeking to reduce costs to maximise surplus revenue to help finance future builds (Inside housing, 2016). Due to high volumes of defects, repairing defects is the largest expense for most HAs (HouseMark, 2012) and improving how they learn from defects is seen by the HAs as crucial to meet their challenges. This paper explores how UK HAs are seeking to improve how they learn from past defects.

EMPIRICAL SETTING

Learning from defects has often been argued as a means for reducing defects in the literature. Egan (1998), for example, recommends that construction organisations should methodically assess completed projects, to feed the knowledge gained back into development processes to improve. More importantly, learning from defects in house building has been viewed as a means of reducing repair costs. It is argued that auditing defect repair costs and implementing appropriate process improvement strategies has potential to eliminate the costs associated with repairing defects (Love, 2002). The benefits of learning from defects are consistent and improving the way HAs learn from defects is seen by the HAs as a key opportunity to reduce defects and maximize surplus revenue. For example, continuously studying past performance and improving future practice based upon the knowledge gained has been seen by HAs as a means of reducing response repairs (repairing defects) (Coastline, 2015).

Similarly, continuously monitoring previous expenditure (including repair expenditure resulting from defects) and improving performance based upon the understating gained from that monitoring is viewed by HAs as a means of reducing costs (e.g. Arcon, 2015). Guided by organisational learning theory, Hopkin *et al*. (2016) found that HAs begun their learning and defect reduction efforts by analysing their post-completion defect data. The data was recorded by a number of actors/actor groups who were involved as part of the HAs' defects management processes: call centres, the aftercare teams, and clerk of works. Based upon the HA's analysis and the gained understanding of what was going wrong within their properties, they could (if feasible) implement change that may result, and has been indicated to result in a reduction in the targeted defects. The HAs were found to be restricting their learning to a short-term solution of reducing defects through product and system adaptations.

The work by Hopkin *et al*. (2016) further indicates that focusing on product and systems adaptations alone supresses HA's abilities to reduce defects in the future. Whilst the previous studies have offered insights on how HAs learn from defects, and proposed potential areas of improvement, and HAs have outlined their desire to improve their learning, there is limited research to explore what changes HAs are actually making to improve their learning from defects practice in an effort to remain viable businesses in the face of their current challenges.

RESEARCH METHODOLOGY

Case study context

The HA presented in this research are a provider of around 1,000 new affordable homes per year in the south of England and have a build stock of over 20,000 homes. The HA are committed to helping ease the UK's housing shortage by developing new homes to rent, as well as for sale via shared and private ownership schemes. The HA have 'a development arm' responsible for building new homes and 'an asset management arm' responsible for managing the build stock (including defects). The HA can use any surplus revenue they make from rental income (including service

charges) and the sale of homes to maintain existing homes and help finance new ones. The HA have a desire to reduce defects in their new homes and the associated repair costs to maximise surplus revenue to increase their production of new homes and believe that improving the way they learn from defects can achieve this. The HA are unable to find a clear improvement opportunity but are intent on taking action.

Methodological lens

Soft systems methodology (SSM) was deemed suitable for this research as it is well suited to ill-structured real world problems (in this case improving how the HA manages and learns from defects with no clear improvement opportunity) (Khisty, 1995). SSM is defined as "an organised, flexible process for dealing with situations someone sees as problematical, situations which call for action to be taken to improve them, to make them more acceptable, less full of tensions and unanswered questions" (Checkland and Poulter, 2006:4). Problematical situations contain people who are trying to act purposefully, with intention (in this case managing and learning from defects). The use of SSM as an approach to assist stakeholders to achieve a common understanding of the problematical situation in construction have been demonstrated in Green's work (1999) that suggests SSM has potential to improve value management practice in the early stages of a construction project.

SSM aims at bringing around an end to the "problem" through accommodations to enable action to be taken to improve the situation with a focus on implementing change. SSM provides a set of principles which can be both adopted and adapted (in any way which suits the specific nature of each situation in which it is used) for use in any real-world situation in which people are intent on taking action to improve it (as is the case with the HA presented in this research) (Checkland and Poulter, 2006). The drawbacks of SSM are that it requires large input and participation from those involved over a sustained period of time. Moreover, when applying the SSM, the researcher needs to acknowledge himself/herself as an active part of the problematical situation and not a neutral observer (Green, 1999). SSM, in its idealised form, is designed as logical sequences of four stages (Checkland, 2000). (1) Finding out about a problematical situation: the key tasks are to undertake exploratory discussions with people in the situation to identify the main stakeholders and the situation (and potential issues) at present. (2) Formulating a relevant purposeful activity model: a purposeful activity model is a model of the activities which fulfil the respective stakeholders' worldviews and form an ideal system state (Ramage and Shipp, 2009). To build a purposeful activity model, a clear definition of the purposeful activity is required, in SSM known as "root definitions" (Checkland, 2000). Root definitions develop each stakeholder's view as a sentence (Paul *et al*., 2013). The differences between these definitions can be compared to identify where they overlap and where they are in conflict with each other, which can lead to the development of a consensus model which can be used to explore possible improvements to the current situation (Paul *et al*., 2013). The primary aim of purposeful activity models are to stimulate cogent questions in debate about the current situation and the desirable changes to it. (3) Debating the situation: the starting point of debating the situation is to compare the purposeful activity model (i.e. the ideal system state) to the current situation. The differences between the models and the current situation provide a fruitful arena to discuss conceivable changes to the problematical situation (Khisky, 1995), e.g. what change is needed; why it is needed; how it can be achieved; what action is required; and, who will take the action. The aim of the debate is to identify changes which would improve the situation and are regard as both desirable and feasible which

respective stakeholders can live with (Checkland, 2000), and accommodate between conflicting interests which will enable action-to-improve to be taken. (4) Taking action: when stakeholders accept changes to be systemically desirable and culturally feasible (Khisky, 1995) the final activity is taking action to improve the situation.

Data collection and analysis

To-date, data collection consisted of one semi-structured interview, one focus group and a review of relevant organisational documentation. The data collection methods and participants who participated within SSM's four stages are described below.

(1) Finding out about a problematical situation: the problematical situation was entered in June 2015 as part of research that sought to explore how HAs learnt from defects. The HA were one of twelve self-selected HA case studies. The interviewees were selected for their expert knowledge of, and involvement in, the defects management process, and introducing change within their HA. The participants were: the Head Clerk of Works, the Aftercare Administrator, the Quality Manager and the Asset Manager. The interview questions asked to gain insight into the HA's defect management and learning processes are listed as follows: Q1: Do you record post-completion defect data?; Q2: At what level of detail is the data captured?; Q3: Do you analyse defect data?; Q4: How frequently is the analysis undertaken?; Q5: Why do you analyse defect data?; Q6: How do you decide that the findings present a need for a change?; Q7: If a change is needed, how do you identify adaptation options?; Q8: How are adaptation options decided and selected, and by who?; Q9: Once selected, how are the new processes communicated around the organisation?; and, Q10: When implemented, how do you monitor the new processes to ensure they are viable? During the interview field notes were taken. Upon completion of the interview the field notes were typed up and sent to the participants to verify and update as necessary. In addition, further data were obtained by analysing the HA's defects management procedures and defect records. The data was thematically analysed.

(2) Formulating a relevant purposeful activity model; and, (3) debating the situation: a focus group took place in October 2015 with three participants from the HA's asset management arm: the Head Clerk of Works, the Aftercare Administrator, and the Asset Manager. The aim of the focus group was to explore the situation the stakeholders identified as problematical to understand the HA's issues in order to bring about change. During the focus group, the participants were asked two questions: Q1: What is your current system supposed to enable you to do?; and, Q2: What activities would be required in order to achieve the described system? During the focus group field notes were taken as audio recording was not permitted.

(4) Taking action: shortly after the focus group a follow-up email was sent to the participants which reiterated the areas for improvement identified and potential options that the HA may want to consider as a means of achieving those improvements. After the initial email regular follow-up communication was maintained with the participants to check on progress. The taking action is on-going and next step is a follow-up interview with the participants to evaluate if the HA's defect management practice (the problematical situation) is improved after the action has been taken (the application of a defects assessment information system).

KEY RESULTS

This section is structured using the four stages of the SSM model.

Finding out about a problematical situation

The key results indicate that the HA's defect management and learning process (current situation) can be generally grouped into two phases: the defects management phase (interview questions 1 and 2) and the learning phase (interview questions 4 to 10). Each phase, the key stakeholders involved are described below.

The defects management phase, undertaken by HA's asset management arm includes eight key activities (from 1 to 8). First, the home occupant contacts the HA's call centre to report a defect. Second, the call centre refers the request to the Aftercare Administrator via an email, who records the provided information in their spreadsheet. The Administrator typically records three themes: the date the defect was reported; the property details (address, property completion date, associated scheme ID, contractor responsible for the build, type of construction, and any associated warranty policy details); and, the details of the person reporting a defect. Third, the Aftercare Administrator contacts the home occupant to discuss the defect further to gain additional information regarding the nature of the defect and then records this information within a free-text field in the spreadsheet. Fourth, the Administrator contacts a clerk of works to arrange an investigation on the case. Fifth, the Clerk of Works investigates the defect. Sixth, the Clerk of Works reports the investigation findings back to the Administrator who updates the details within the free-text description field within the spreadsheet. Seventh, based upon the findings of the investigation, the aftercare team (the Head Clerk of Works or Administrator) then arranges for remediation of the defect (either through a contractor or the warranty provider if there is a warranty in place). Finally, once the remediation arrangement is made, the aftercare team will monitor until completion, at every stage recording: the status of the repair (i.e. ongoing, completed), the repair cost, any cost savings; and, any changes to the scope of the repair or defect identified.

The learning process includes four key activities and is heavily reliant on analysing the data captured during the defects management phase. First, on a weekly basis the HA's asset management arm (the Asset Manager, Head Clerk of Works and Aftercare Administrator) manually analyse the defects spreadsheet together to monitor contractor and product and system performance, in order to identify improvement opportunities to reduce defects (typically high volume defects). Second, the Asset Manager (the asset management arm) and the Quality Manager (the development arm) discuss the problem areas during bi-monthly meetings. In cases where the problem areas are deemed significant enough (a perceived level of value by the individuals) to warrant a change to the HA, the Quality Manager tends to seek solutions.

The HA's focus at this point is primarily to design out defects through product and system changes, and these changes are typically identified by either reviewing schemes that are generally performing well in the given problem area, or through internal and external people being invited to offer solutions to the given problem. Third, when a viable solution to the given problem has been identified the proposal is put forward to a review panel consisting of a leadership group (HA's senior management). The leadership group then review the proposal. If the proposal is deemed suitable for the HA, the HA's 'employers requirements' (the specification to be used for all builds) are updated and used for subsequent projects. The HA use data analysis to identify both improvement opportunities and monitor whether a change has been successful. Finally, in addition to the specification updates, networking (informal internal communication) is undertaken by way of the Head Clerk of Works

(who focusses on defects post-completion) feeding back the problem areas to site teams (the clerk of works, who the Head Clerk of Works manages and investigate new builds and post-completion defects) as ‘areas to watch’ on future builds.

It became clear that three key stakeholders within the HA desired to improve their learning and defects management practices. They, however, could not identify a clear improvement opportunity, but were intent on making changes. A focus group was arranged to further explore the perceived systems of concern as described below.

Formulating a relevant purposeful activity model

The focus group started with the facilitator (the first author) outlining his understanding of the HA’s current situation (based upon stage 1 above) to ensure it was accurate. The individual participants were then asked to explicitly outline what their defects management and learning system was meant to enable them to do (their world views) (focus group question 1). It was found that there were two contrasting views among the three participants. The Aftercare Administrator had a short-term view pertaining solely to the repair process and suggested that the system is in place to provide the home occupants with a good repair service by stating that "the current spreadsheet in place was started from a blank canvas and developed based upon the experience of the job role. The system exists to help us [the housing association] to manage the defects process and record detailed defect data to enable us in providing the customers with a good repair service, that they can be satisfied with". In contrast, the Head Clerk of Works and Asset Manager had a long-term view of defect and repair cost reduction when they advised that "the system should provide us [the housing association] with an informed view of what is going wrong in homes, so I can feed this back to my site teams to make them aware of problematic areas of work, which should help us to reduce defects moving forward" and "the system in place should provide real time information and knowledge of specific defects in homes to develop solutions to help us [the housing association] achieve long-term cost savings and defect reduction through identified improvement opportunities" respectively.

After identifying the individual stakeholder’s world views a purposeful activity model was developed to depict what the HA’s defect management and learning system was meant to enable them to do. Theoretically, SSM would seek to develop a purposeful activity model for each of the three key stakeholder's worldviews for discussion due to different interests, expectations and interpretations of the defect management system. However, after outlining their individual worldviews in the focus group, a discussion among the three key stakeholders took place and a level of consensus was reached in regards to what the system of concern is and what it should (ideally) do.

From this consensus the following clear definition of the purposeful activity was developed: “The defects management system is owned by the Asset Manager, who together with the Aftercare Administrator and Head Clerk of Works, captures post-completion defect data from the home occupants in order to manage the defects remediation process to a satisfactory completion, and provides real-time information as the basis of the learning process to help identify improvement opportunities for future projects; and, by doing so, to satisfy customers, reduce targeted defects and reduce long-term repair costs associated with new homes”. Developing the consensus model (figure 1) involved asking the collective stakeholders to clearly outline what activities would be required (step-by-step) for the described system to work (focus group question 2). The consensus model of the HA's defects management system consists of the following nine activities.

First, a report of a defect is received by the aftercare team and logged within the HA's defects management system. Second, the site environment is entered and the defect is investigated and detailed defect data captured. Third, based upon those detailed investigations the scope of work is established and the repair scheduled. Fourth, from the repair schedule the necessary materials, contractors and equipment are procured. Fifth, the repair is undertaken. Sixth, acceptable performance measures such as estimated repair durations and agreed costs are predefined. Seventh, whilst activities 2, 3 and 5 are being undertaken in the site environment, these three activities are monitored by the aftercare team (business environment) against predefined performance measures (activity 6). Eighth, if the acceptable measures are exceeded then action is taken by the aftercare team to get the site work back on track. The final activity, also 'a new activity', is that upon completion of the repair, the aftercare team have discussions with the home occupant and identify their level of satisfaction with both the repair and service quality.

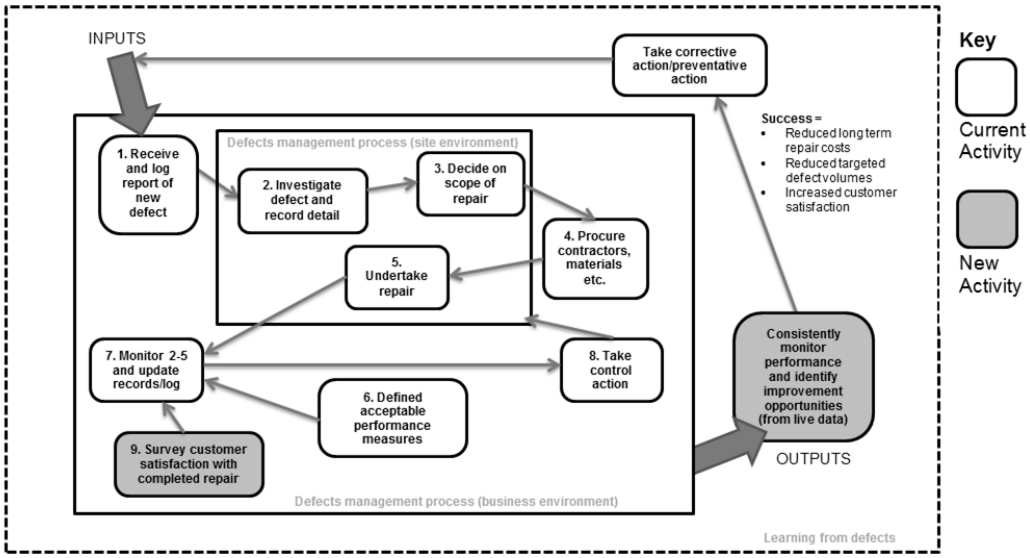


Figure 1: Consensus model of the HA's defects management system - the ideal system state

During the learning process, the Asset Manager will monitor performance and identify potential improvements by extracting live data reports from the defects management information system (a new activity). The data extraction is then used as the catalyst for corrective and preventative action (taken forward with other actors in the process) to reduce the prevalence of defects in future homes, decrease the long-term cost of repairing defects in the HA's build stock; and, increase the home occupants satisfaction with the repair service.

The consensus model identifies two new activities: surveying customer satisfaction, and live data analysis.

Debating the situation

The consensus model (figure 1) was used to explore possible improvements to the current situation, by comparing the ideal system state with the current situation. It was found that there is a clear mismatch between what the current system should be doing to enable the HA to manage and learn from defects, and reality (the current situation). The HA's Asset Manager asserted that they can no longer go on using their current system due to its disadvantages, and confirmed that he will take action. The primary disadvantages of the current system are: a) the laborious data analysis procedures associated with manually reviewing long free-text descriptions; and, b) the

inability for the HA to track the home occupant's satisfaction with the repair service (the two new activities outlined in the consensus model). a) The HA's current defects management system is centred around a standard spreadsheet which is reliant on manual text input for recording all details of the defects reported and the subsequent repair processes. At present the HA's sole way of capturing details of defects reported is through the use of a free-text field within that spreadsheet, which typically contains a long string of text outlining various details pertaining to the defect, with no simplified description or category (such as building area) to aid trend identification.

The HA's current defect analysis approach is in stark contrast to the live data analysis capabilities outlined for the ideal system state. The HA identified a strong desire to develop a bespoke defects management information system that allows the HA to look-up property records for their existing build stock. After identifying the property where a defect occurs, the HA would like to be able to: create a new defect record (including a category by building area); input customer details; arrange an investigation; arrange for the defect to be remedied; and, document and track progress along the way. Based upon the data held within the system, the HA also desire to have the capability to undertake live data analysis and reporting to track cost and trends of specific defects, displayed via a dashboard. b) The HA do not have any mechanism in practice to record the home occupants level of satisfaction with repairs and therefore cannot analyse customer satisfaction. The HA wish to bring in a new process of surveying the home occupants satisfaction with repairs.

Taking action

Building upon the desired changes identified when debating the situation, a number of potential options were proposed to the HA by the researcher. These options were identified from other HA's working practices discussed in previous literature (Hopkin *et al*., 2016), including: (1) categorising defects by building area to enable the HA to identify specific areas of focus and to facilitate live reporting; (2) recording the details of the contractor responsible for the original build along with the number of plots they produced to aid the HA in distinguishing the number of defects per unit built and a true representation of contractor defect related performance; (3) recording the scheme region to help the HA develop an understanding of any particular regional trends, so that the HA can tailor specific guidance to the site-based teams in that area; (4) recording the priority of the repair (e.g. urgent, routine), to assist the aftercare team in managing the repair process; (5) recording whether a complaint had been made during the repair process to assist the HA in gauging the home occupants level of satisfaction with the service provided (in addition to the proposed satisfaction survey); and, (6) analyse defects by their individual impacts (a proposed new weighting system). Among these six options, the development of a new weighting system for defects (option 6) was the only option rejected by the HA. The remaining five options were further converted by the HA into two actions. The first action was undertaking an immediate short-term solution of updating their spreadsheet and processes to categorise defects, record repair priority, record complaints and introduce a customer satisfaction survey. The second action was to introduce a long-term solution of developing a bespoke defects management system with live data dashboard: this action is currently being developed by the HA's IT department.

DISCUSSION

The HA presented in this research were intent on taking action to improve their defects management and learning practices to adapt to the current pressures of

increased defects in new homes and reduced funding, however, with no clear improvement opportunity identified. The review of the HA's defects management and learning processes found that they used data captured by their defects management system and analysis of that data as the basis of their learning and improvement. The HA's current system was not doing what the participants believed it was doing. Each participant had an individual view of what the system should enable them to achieve, however through discussion a level of consensus was agreed. Two new activities were found to be required in order to bring the system in line with the HA's expectations which were: the development of a bespoke defects management system with live data reporting, and the introduction of a satisfaction survey (for repairs).

This research started with the researcher (the first author) as an outsider who was aiming to better understand HAs learning processes. From the initial interaction to the research presented in this paper, the researcher's role moved from an outsider to an active part in one HA's change. When becoming actively involved in the research, it's vital to acknowledge that involvement and the effect it may have. The principles of SSM allowed the researcher to maintain a level of neutrality until the HA had identified desirable and feasible changes. However, by discussing other HAs practices with this HA and making recommendations, the researcher is likely to have influenced the HA's view of what action they should take.

CONCLUSION

This paper contributes to our understanding of the HA's quest for improvement by reporting one HA's efforts to identify new opportunities to advance their defects management and learning practices. The HA in this case were keen to improve to meet their current challenges but could not identify a clear improvement opportunity - this may be the case with many HAs at present. The HA was found to be reliant on their defects management system (and analysing data captured from that system) as the starting point to trigger their learning processes. However, the HA's current defect management system is not doing what it is intended to do. The HA believed that a system modification was necessary to improve their management of defects and enhance their learning via live data analysis/reporting. The adoption of SSM in this research has made it possible for the HA to explore the situation the stakeholders identified as problematical (facilitated by the researcher) to understand their issues.

More importantly, the flexibility of the SSM (the ability for the study to commence at any point) allowed the principles to be adapted to suit the specific situation, as the study first adopted the SSM principles after previously finding out about a problematical situation (where people were intent on taking action to improve and had asked the researcher to assist). The flexibility of SSM shown in this research further supports Winter's (2006) argument that the SSM principles can be converted into a situation-specific approach. Further, due to its flexibility, SSM, primarily through the structured discussion in the focus group surrounding what the system should be doing and the reality of the situation, made the deficiencies of the HA's current system apparent to them and enabled them to recognise desirable and feasible changes.

The identified modifications have the potential to bring about positive change in the HA in both their learning and the way in which they approach the repair process. Whilst the researchers have suggested potential changes that the HA may find useful as a means of assisting the HA in achieving their aims, it is the HA who will decide on which options are desirable and feasible to them and what changes they will make. In

a practical sense, the findings show that the principles of SSM can aid any HA who is seeking to improve (to meet challenges) but have no clear improvement opportunities.

ACKNOWLEDGEMENTS

The authors thank National House Building Council and the Engineering and Physical Sciences Research Council (grant: EP/G037787/1) for their funding and support.

REFERENCES

Arcon Housing Association (2015) *Value for Money Self-Assessment*. Arcon Housing Association. Online http://bit.ly/1Pg34iS [27/4/16].

Checkland, P (2000) Soft Systems Methodology: A Thirty year Retrospective. *Systems Research and Behavioral Science*, **17**(1), 11-58.

Checkland, P and Poulter, J (2006) *Learning for Action: A Short Definitive Account of Soft Systems Methodology, and Its Use Practitioners, Teachers and Students*. Chichester: John Wiley and Sons.

Coastline (2015) *Asset Management Strategy 2015-2020*. Cornwall: Coastline Housing.

HM Government (2015) *Live Tables on House Building - Statistical Data Sets*. London: Department for Communities and Local Government. Online http://bit.ly/1mnnuhA [18/9/2015].

Egan, J (1998) *Rethinking Construction*, Norwich: Her Majesty's Stationery Office.

Green, S (1999) A participative research strategy for propagating soft methodologies in value management practice. *Construction Management and Economics*, **17**(3), 329-340.

Home Builders Federation (2016) *National New Home Customer Satisfaction Survey*. London: Home Builders Federation.

HM Treasury (2015) *Summer Budget 2015*. London: HM Treasury.

Holmans, A. (2013) New estimates of housing demand and need in England, 2011 to 2031. *Town and Country Planning Tomorrow Series*, Paper 16, 1-32.

Hopkin, T, Lu, S, Rogers, P, and Sexton, M. (2016) Detecting defects in the UK new-build housing sector: A learning perspective. *Construction Management and Economics*. **34**(1), 35-45.

HouseMark (2012) *Value for Money in Responsive and Void Repairs*. Coventry: HouseMark.

Inside Housing (2016) *Is It Time For A Change?* Online http://bit.ly/1RBvBAm [1/4/2016].

Khisky, C (1995) Soft-systems methodology as learning and management tool. *Journal of Urban Planning and Development*. **121**(3), 91-107.

Jefferys, P, Lloyd, T, Argyle, A, Sarling, J, Crosby, J and Bibby, J (2014) *Building The Homes We Need: A Programme For The 2015 Government*. Shelter and KPMG LLP, Switzerland.

Love, P E D (2002) Auditing the indirect consequences of rework in construction: a case based approach. *Managerial Auditing Journal*, **17**(3), 138-146.

National Housing Federation (2015) *Briefing: Summer Budget 2015*. London: National Housing Federation.

Paul, D, Yeates, D, and Cadle, J (2013) *Business Analysis (2nd Edition)*. BCS, Swindon.

Ramage, M and Shipp, K (2009) *Systems Thinkers*. London: Springer.

Winter, M (2006) Problem structuring in project management: an application of soft systems methodology (SSM). *Journal of Operational Research Society*, **57**(7), 802-812.

ARE HOUSEBUILDERS' PRODUCTION STRATEGIES A BARRIER TO OFFSITE CONSTRUCTION UPTAKE IN THE UK?

Ron Lang[1], Chris Goodier and Jacqueline Glass

Centre for Innovative and Collaborative Construction Engineering, Loughborough University, Epinal Way, Loughborough, Leicestershire, LE11 3TU, UK

More than three-quarters of all new UK housing is currently delivered by the private sector using predominantly traditional, site-based, construction methods. Recently, the house-building industry has found itself under increasing pressure to raise production output to alleviate a shortage in housing supply and reduce house price inflation. Within this setting, there has been much interest in the potential offered by off-site construction (OSC). The production strategies employed by private house-building firms however, are a direct response to their operational environment, and the adoption of OSC would arguably alter the way that they deliver their developments. Hence, there is a clear need to understand the relationship between production strategy and construction methods. Based on a case study of one of the largest private house-building firms in the UK, the potential impacts of OSC on current production strategies have been explored. The results indicate that the adoption of OSC approaches may alter the manner in which house-building firms are able to manage their production process, reducing their control and restricting the very flexibility on which their own success relies. The findings have implications for the housebuilding industry, OSC manufacturers and construction research, given the ongoing interest in OSC as a means to address the UK's housing supply issues.

Keywords: housebuilding, methods, organisation, off-site, production, strategy.

INTRODUCTION

The UK housebuilding industry faces increasing pressure to address a growing housing supply problem. In 2004, Kate Barker's Review of Housing Supply concluded that 245,000 new homes were required each year in order to meet household growth and reduce house price inflation (Barker 2004). Following the financial crash of 2007/8, and a significant decline in housebuilding activity, the UK now finds itself 1.5 million homes short of Barker's targets (HBF 2014). Despite a sustained period of recovery in recent years, just 145,000 new homes were completed in 2015 (GOV 2016) against a current estimated need in excess of 300,000 homes per year (HBF 2014). Such figures highlight the scale of the problem faced by the industry, and indeed the country.

It has commonly been argued that off-site construction (OSC) could offer a solution to the UK's under-supply problem (Housing Forum, 2002; NAO, 2005; Miles and Whitehouse, 2013). Yet, despite reoccurring phases of government and industry interest in OSC, uptake by private housebuilding firms remains low (Pan et al, 2008;

[1] a.lang@lboro.ac.uk

Lang, R, Goodier, C and Glass, J (2016) Are Housebuilders' Production Strategies a Barrier to Offsite Construction Uptake in The UK?. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1245-1253.

Taylor 2010). Using a case study of one of the largest private housebuilding firms in the UK, we examine housebuilders' current production strategies (i.e. strategies employed during the construction phase of new housing developments) and explore how OSC adoption could impact upon them. These initial findings go some way to accounting for the lack of adoption of OSC in mainstream housebuilding construction.

UK housing supply

Since the rapid decline in public sector housebuilding during the 1980's, the private sector has delivered more than three quarters of all new housing in the UK (GOV 2016). Total supply has more than halved since the 1970s, although the average private sector contribution has remained fairly constant with annual completions of around 140,000 units per annum (Miles and Whitehouse 2013). The private sector is represented by a diverse mix of firms, from large multi-national developers, to small local builders. However, recent decades have seen the increasing dominance of a relatively small number of large housebuilders (Ball 2010; Callcutt, 2007), the top ten of which deliver around half of all new homes (HBF 2015, GOV 2016). As such, any increase in housing supply appears disproportionately reliant, not only on the private sector, but on a small number of individual firms.

The majority of these housebuilders operate under the 'current trader' or 'classic' business model, overseeing all aspects of the development cycle from land acquisition through to construction and sale (Callcutt 2007; Ball, 2010). Homes delivered in this manner are built speculatively for the owner-occupier and investment markets, relying on good local market knowledge to deliver profitable returns. However, it is widely accepted that the UK has a volatile housing market with persistent, though unpredictable, boom and bust cycles. This creates an uncertain, and therefore risky, operational environment (Barker 2004; Callcutt 2007; Ball 2010).

It is no surprise then, that housebuilders are conservative in their approach to production; managing the pace of production to suit sales rates (Callcutt 2007; Miles and Whitehouse 2013) and responding quickly to changes in market conditions (Ball 2010). Indeed, Ball (2010) suggests that it is this inherent need for flexibility which leaves housebuilders wedded to the use of traditional materials and subcontract labour (Ball 2010). Yet, this relationship, between a housebuilder's production strategy and the construction methods they employ, is an area of research largely unexplored in current OSC literature.

We would argue that a better understanding and appreciation of housebuilders' production strategies is required if the industry is to successfully adopt more OSC as part of a solution to the UK's housing supply problem.

RESEARCH METHOD

Based on the problem context set out above, two overarching research questions are proposed:

18. How do private housebuilders in the UK currently deliver new housing developments (i.e. what production strategies do they deploy?), and why do they do it this way?
19. How would the increased adoption of OSC methods impact upon housebuilders' current production strategies?

This paper reports on the first of a two stage research design, drawing on data collected from a single-firm case study with a major UK housebuilder. This inductive, theory-building exercise will be used to inform a second stage of enquiry

across multiple firms (Lang et al. 2016), recognising the benefits of case study work with regards to depth of data but equally addressing concerns regarding the generalisability of the results (Yin 2014).

The selected case study firm is one of the UK's largest private housebuilders operating nationally through a network of regional and divisional offices. A total of fifteen semi-structured interviews were conducted with key personnel from its head office and two divisional offices. The respondents were carefully selected with the help of the firm's senior management to provide a cross-section of roles throughout the housebuilding process, such as technical directors, commercial managers, procurement managers and contracts managers. All interviews were conducted and transcribed by the primary researcher during the summer of 2014.

An initial question set (based on the literature review and internal documentation) was used to explore the firm's production process. Respondents were then presented with a number of OSC examples to stimulate discussion on the impact of construction methods on production strategy. The use of semi-structured interviewing allowed emerging themes to be incorporated as the case study progressed (Proverbs and Gameson, 2008, Bryman, 2012). Transcripts were written up following each interview and emerging themes were introduced as additional questions. The core set of questions remained the same throughout the interview process to maintain repeatability and ensure comparable data for analysis (Walliman, 2011). Thematic analysis was applied based on the structured method described in Braun and Clarke (2006). All transcripts were coded using a semantic approach, key themes were identified and findings are reported below with reference to both the original research questions and the existing literature.

Given the housebuilder's lack of experience implementing OSC methods at scale, conclusions should be drawn with caution and taken as perceptions and expectations rather than evidence-based observations.

RESEARCH FINDINGS

The research findings are presented with reference to two key themes identified from the data analysis: flexibility and autonomy.

Flexibility

During the construction phase, the amount of 'work-in-progress' (WIP) is continuously monitored in line with current sales rates. Although market dependent, housebuilders generally aim to minimise WIP; organising materials and labour as required to avoid accumulation of completed but unsold housing stock.

> *We could have a plot which goes up to stage one foundations and then it'll stay dormant for another six months until it's sold…then we'll say, ok, a customer likes this plot, we're 'gonna start bringing this one up now" (Senior Design Technician - Group)*

> *"On-site, you could say, stop on that plot, leave that one where that level is we don't need to carry on with that one…its more reactive to the market" (Buyer - Division)*

Accordingly, a number of respondents cited the need to vary production speed in response to sales rates – especially in slower than expected markets. Although current housing market conditions allow housebuilders to construct homes quickly, in slower markets production is carefully controlled, with each sale releasing a new plot for construction.

> [Previously] once we sold it, we built it…occasionally if you've got a row of terraces you end up with a few stock plots, but we wouldn't take them through to completion, we would hold them… effectively that's how we've run our business for the last, probably five years. (Senior Quantity Surveyor - Division)

> [If sales slow down] they will slow me back on the build a little but, the problem will arise that a month later the sales might pick up and, right, we want those houses now. (Contracts manager - Division)

The use of traditional building materials, assembled on site, gives a housebuilder significant flexibility regarding the construction programme. For example, where sales are slow but certain house types are proving more popular, they are able to refocus the construction programme in favour of more popular units.

> At the end of the day, it's pointless building that house over here that's not selling that well…whereas we've got five over here that are selling like hotcakes…Any site is shifting and changing all the time (Senior Design Technician - Group)

> You might say, well actually the market's slowing down a little bit, let's build those affordable [units] over there…or if the market's like banging along it's like, yea people keep coming in saying I want a five bed detached we'll keep thrashing along with those. We do monitor what's going on, so we will re-plan sites. So suddenly we'll say actually this house type, or these houses here, are holding back…and we'll look at redesigning the scheme (Design Manager - Division)

Having reflected on the merits of traditional materials, respondents expressed concern over housebuilders' ability to control WIP, and thus to respond to the market, when employing OSC methods – particularly given the longer associated lead-times. Where the housebuilder commits to the production of a number of units in advance, a slowdown in sales may lead to the accumulation of stock which has already been paid for (or at least contracted to) but cannot be sold. Moreover, the speed at which OSC houses are constructed leaves the housebuilder much less able to control pace of build at the individual unit level.

> If this is a very quick method of construction, then you have to look where sales are because we don't just want to be building stock to stand there (Design Director - Group)

> "Because of the market we're in we have to have that flexibility because otherwise you end up with either a lot of stock of properties that money's tied up in, or you can't build quick enough. I think you have to have [a construction method] that is very flexible to the market demand (Buyer – Division)

Offering a potential solution, some respondents suggested that OSC systems could be procured centrally at the group level and distributed to development sites as needed to alleviate fluctuations in sales demand. However, at present, regional variations in planning requirements were seen to be a significant barrier to the level of standardisation required to operate in this manner. Respondents also acknowledged that this would require a significant amount of planning, storage space and working capital.

> You could be having a pod which you can arrange in different orientations: Group may approve three or four different rooms, and how we then structure them on a particular site or a particular house would be a Divisional choice rather than a Group choice. (Contracts Manager - Division)

> That's where we find a lot of conflicts with local authority; we're pushing standard and they're saying well we don't want standard, we want something that looks a bit more like what's next door to your site. (Contracts Manager - Division)

Autonomy

It is apparent that the suitability of an OSC approach may be development-specific. For example, OSC was deemed more suitable for developments with a high proportion of pre-sales, or poor access to local labour, than for developments with restricted access. Moreover, such factors may change over time, requiring constant evaluation. The firm's current approach to specification – a centrally controlled, national construction specification, supported by large materials purchasing agreements - currently leaves divisional offices with little influence over the construction methods employed. Accordingly, the need for increased autonomy at the firm's divisional levels, when implementing OSC, emerged as a topic of considerable debate during the interview process. This appears to be in contrast with the idea of a centrally controlled procurement arrangement suggested previously.

> [The company] is very much Group led all the way from the top, so they believe everything should be standard…any Divisional alterations should be an absolute minimum (Senior Design Technician - Group)

> Nine times out of ten, by the time I reach developments, the specification has been set (Senior Quantity Surveyor - Division)

A number of respondents expressed concerns regarding commitment to any single OSC system, suggesting that divisions would need to select a suitable approach based on local requirements. It was suggested that having the freedom to choose from a number of group-approved construction specifications (both on- and off-site methods) may allow sufficient flexibility whilst maintaining some level of central control over national construction specifications.

> We won't put all our eggs in one basket and go to a specific system, because we've got to be adaptable…geographically certain products may only be available to certain parts of the country (Senior Commercial Manager - Group)

> …you need that functionality and that ability to change for different scenarios. One system might not work on a particular site where it works perfectly well on another…Group could produce four of five different documents on the ways we could achieve it and then that goes down to the Divisional level on how we want to approach it (Contracts Manager Division)

Respondents working at the Group level also raised concerns over a reduction in 'buying power' where multiple OSC suppliers were utilised. Conversely, it was expected that introducing choice at the Divisional level may increase competition between manufacturers and therefore balance out any buying power lost. Some respondents did not expect the firm to allow increased autonomy on the basis of needing to conserve a nationally recognisable brand and to maintain control over quality across all developments. In addition, concerns were raised over the practicalities of managing multiple specifications and suppliers. The single standard Group construction specification was seen as the main tool with which the firm currently ensures continuity and consistency across its national operations.

> [The centralised structure] all has to do with quality, consistency and of course, commercially, the buying power (Senior Design Technician - Group)

> With [the company] being the size they are, it's that familiarity. If everyone is doing something slightly different, how would that impact upon the brand? (Senior Quantity Surveyor - Division)

DISCUSSION

Drawing on the results presented, the discussion is framed around the two overarching research questions posed earlier.

How do housebuilders currently deliver new housing developments (i.e. what production strategies do they deploy?), and why do they do it this way?

Underpinning the current housebuilding business model is the need to respond rapidly to uncertain market conditions (Ball 1999, 2010). Careful management of cash-flow is key during the production phase and WIP is continuously monitored and controlled in line with sales rates (Venables et al 2004; NHBC 2006; Callcutt 2007; Ball 2010; Payne 2016).

Therefore, in contrast with Adams and Leishman (2008), we propose that the need to vary the production speed in line with market conditions is a critically important component of housebuilders' current production strategies.

The circumstances in which production speed is altered appear almost exclusively related to *poor* market conditions, with respondents making little reference to what the housebuilders' typical response was to *higher* than anticipated sales. This distinction may support the view that housebuilders are generally unwilling to increase production beyond planned rates as it is not profitable to do so (Callcutt, 2007; Adams and Leishman, 2008; OFT, 2008; Miles and Whitehouse, 2013).

In line with Adams and Leishman (2008), changes to the mix of house types contained within the development (re-mixing) did not appear to form part of the firm's production strategy. However, the need to adjust the construction programme to progress more popular house types or plots (re-programming) *was* identified. As with variation of production speed, alterations to the construction programme appeared to take place during poor market conditions, although the specific conditions under which re-programming is, or can be, undertaken was again unclear.

How would the adoption of OSC methods impact upon housebuilders' current production strategies?

Although the findings lack clarity with regards to the extent and conditions under which production speed and programme are varied during the production phase, it is evident that the use of traditional construction methods supports a 'flexible' production approach (Ball 1999, 2010; Payne, 2009; Housing Forum 2012). Housebuilders can currently adjust production speed at both the unit level (how quickly each house is constructed) and the development level (how many houses are under construction). Additionally, as the core materials used are not plot specific and may easily be moved around the development site, housebuilders are able to purchase materials without committing to the timing or location of their assembly.

In agreement with Ball (2010), respondents suggested that the adoption of OSC methods would reduce housebuilders' flexibility to respond to changes in the housing market. The longer lead-times associated with OSC methods (i.e. the off-site manufacturing stage) require the housebuilder to commit to a production schedule significantly in advance of sales. Where market conditions decline, or are not as anticipated, respondents felt housebuilders may be powerless to reduce WIP, and limit capital exposure, accordingly. As identified by Pan (2006) the risk of committing to production so early is a key concern for housebuilders looking to adopt OSC – there is a keen sense of a risk that they will no longer have full control of production on site.

However, it should be noted that the need for flexibility during production is a response to conditions of market uncertainty (Ball 1999, 2010; Barlow et al. 2003). As such, where the operational environment is more predictable (e.g. a significant proportion of the development is sold from plan), it seems logical to assume that the need for flexibility in production would diminish. Notwithstanding the need for further research on this aspect, we may therefore infer that a decision to employ OSC methods should be made on a development-specific basis, thereby accounting for local factors and their influence on the production strategy employed.

CONCLUSIONS

The UK housebuilding industry is under pressure to address a long-term lack of new housing supply in the UK. Around three quarters of all supply is delivered by private sector housebuilders, and any increase in supply is disproportionately reliant on a small number of large firms. The adoption of OSC has often been advocated as a solution to supply constraints and, yet, uptake by housebuilders remains low.

On the basis of this case study, we feel that an argument can be made that an understanding of the environment in which housebuilding firms operate, and the production strategies that they employ in response, is critical to the adoption of more innovative methods of construction such as OSC.

A single-firm case study within one of the UK's largest housebuilding firms has identified that flexibility (in production speed and programme) form integral components of housebuilders' production strategies. The adoption of more OSC methods was believed to limit flexibility and thus reduce their ability to respond to changes in housing market demand.

We therefore argue that the relationship between construction *method* and production *strategy* should form an integral part of housebuilders' OSC decision-making processes, and that the use of OSC methods should be determined on a development-specific basis. In our case study such a devolved decision-making approach was not evident, perhaps explaining why the case study firm had not adopted OSC.

When considered as a mechanism or lever for change within a firm, it is also clear that the concept of 'flexibility' in housebuilding production (Ball 1999, 2010) requires greater research and a more detailed and explicit definition, especially given its relationship to the selection of construction method. Certainly, in the case investigated here, the idea that OSC could solve the UK housing supply crisis seems to lack consideration for the manner in which the majority of new homes are delivered.

ACKNOWLEDGEMENT

The research reported here was funded through an Engineering Doctorate, supported by the Engineering and Physical Sciences Research Council, via the Centre for Innovative and Collaborative Construction Engineering at Loughborough University. The authors are grateful to the case study firm and personnel who kindly participated in the research.

REFERENCES

Adams, D and Leishman, C (2008) *Factors affecting house build-out rates*. Glasgow: University of Glasgow.

Ball, M (1999) Chasing a snail: innovation and housebuilding firms' strategies. *Housing Studies*, **14**(1), 9-22.

Ball, M (2010) *The housebuilding industry: Promoting recovery in housing supply*. London: Department for Communities and Local Government.

Barker, K (2004) *"Review of housing supply"*. London: HM Treasury.

Barlow, J, Childerhouse, P, Gann, D, Hong-Minh, S, Naim, M and Ozaki, R (2003) Choice and delivery in housebuilding: lessons from Japan for UK housebuilders. *Building Research and Information*. **31**(2), 134-145.

Braun, V. and Clarke, V (2006) Using thematic analysis in psychology. *Qualitative Research in Psychology*. **3**(2), 77-101.

Bryman, A (2012) *Social Research Methods* (4th edition). Oxford: Oxford University Press.

Callcutt, J (2007) *The Callcutt Review of Housebuilding Delivery*. London: Department for Communities and Local Government.

GOV (2016) *Live Tables on House Building*. Available at: https://www.gov.uk/government/statistical-data-sets/live-tables-on-house-building [Accessed 30 March 16].

HBF (2014) *Barker Review: A Decade On*. London: Home Builders Federation.

HBF (2015) *Housing Market Intelligence Report 2015*. London: Home Builders Federation.

Housing Forum (2002) *Homing In on Excellence: A Commentary on the Use of Offsite Fabrication Methods for the UK Housebuilding Industry*. London: The Housing Forum.

Housing Forum (2012) *Rationalising Regulations for Growth and Innovation: A Report From the Housing Forum Working Group On Innovation And Regulation in Housing Construction*. London: The Housing Forum.

Lang, A, Goodier, C, Glass, J (2016) Flexibility in production: Private housebuilding production strategies and offsite construction uptake. *"Construction Management and Economics"* (IN DRAFT).

Miles, J and Whitehouse, N (2013) *Offsite Housing Review*. London: Construction Industry Council.

National Audit Office (2005) *Using Modern Methods of Construction to Build Homes More Quickly and Efficiently*. London: National Audit Office.

NHBC Foundation (2006) *A Guide to Modern Methods of Construction"*. Buckinghamshire: NHBC Foundation.

Office of Fair Trading (2008) *Homebuilding in the UK: A Market Study"*. London: Office of Fair Trading.

Pan, W (2006) *A Decision Support Tool for Optimising the Use of Offsite Technologies in Housebuilding"*. Doctoral Thesis. Department of Civil and Building Engineering. Loughborough University, UK. Available from https://dspace.lboro.ac.uk/2134/7856.

Pan, W, Gibb, A and Dainty, A (2008) Leading UK housebuilders' utilization of offsite construction methods, *Building Research and Information*, **36**(1), 56–67. Available from https://dspace.lboro.ac.uk/2134/6181.

Payne, S (2009) *The Institutional Capacity of the UK Speculative Housebuilding Industry: Responding to the brownfield development policy agenda*, Doctoral Thesis, Department of Urban Studies, Faculty of Law, Business and Social Science, University of Glasgow.

Payne, S (2016) *Examining Housebuilder Behaviour in A Recovering Housing Market: Recommendations for Improving Britain's Housing Supply*. Department of Urban Studies and Planning: University of Sheffield.

Proverbs, D and Gameson, R (2008) Case study research. In Knight, A and Ruddock, L (Eds) *Advanced Research Methods in the Built Environment*. London: Wiley-Blackwell.

Taylor, M (2010) A definition and valuation of the UK offsite construction sector, *Construction Management and Economics*. **28**(8), 885–896.

Venables, T, Barlow, J and Gann, D (2004) *Manufacturing Excellence: UK Capacity in Offsite Manufacturing*. Innovation Studies Centre.

Yin, R K (2014) *Case study research: Design and methods*. London: Sage Publications.

FIVE STAR STATUS IN THE UK HOUSE BUILDING SECTOR: A REALISTIC INDICATION OF CUSTOMER SATISFACTION OR PURE FANTASY?

Chris Boothman[1] and Nigel Craig[2]

[1] *School of Engineering, University of Bolton, Deane Road, Bolton., BL3 5AB, UK*

[2] *School of Engineering and Built Environment, Glasgow Caledonian University, Glasgow UK*

The Barker Review of Housing published in March 2004 commanded that "the house building industry must demonstrate increased levels of customer satisfaction" and called for the Home Builders Federation (HBF) to develop a strategy to improve the level of customer satisfaction. In partnership with the National House Building Council (NHBC) the HBF introduced a national survey of house builders, which launched in 2005 as a self-completion survey to the purchasers of new build homes at both eight weeks and nine months after legal completion. The results for two questions "quality of the home" and "recommendation to a friend" culminate in the award of a star rating between one and five and the surveys completed over the past decade show steady improvement in relation to customer satisfaction. Further research was conducted to examine how the data collected by the NHBC is used in practice to improve the service provided to the customers, the transition of any changes into practice and the overall management of the customer satisfaction process by the builder. In order to explore how this data is utilised in practice, eight semi structured in depth interviews have been carried out with three developers and analysis of the exploratory data revealed a gap between the published statistics and current practice and further suggests the HBF surveys were unlikely to reflect the true experiences and opinions of the customer. The research concluded that the customer can be manipulated by the builders in some cases causing a bias in the market; on the whole the customer satisfaction surveys and star rating are simply seen as a marketing tool, used by the builders marketing department as a sign of quality and a way to promote the company.

Keywords: customer satisfaction, quality, defects, housing

INTRODUCTION

For over twenty years the construction industry has seen a continuous outcry from both the government and customers for an improvement in the quality of new homes constructed by the house-building sector in the UK. As a result of the findings of the Mori/House Builders Federation (HBF) surveys completed between 2000 and 2003 and the Barker Review of Housing (2004) the National House Building Council (NHBC) in partnership with the HBF introduced a national survey of house builders, which launched in 2005 as a self-completion survey to the purchasers of new build homes at both eight weeks and nine months after legal completion. The results of the surveys completed over the past decade indicate that there was a steady improvement across the sector, as commanded by Barker albeit the target of 85% for service quality

[1] jcb1@bolton.ac.uk

Boothman, C and Craig, N (2016) Five Star Status in the UK House Building Sector: A Realistic Indication of Customer Satisfaction or Pure Fantasy? *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1255-1264.

was not met until 2010 for the "overall service provided" and has still to be met for the "after sales service" the builders provide to their customer, however the target set of 75% for the Recommend their house builder was met. Heath (2014) suggests that the decade since the Barker review has been a lost one in terms of addressing the shortcomings of the housing market, which is reflected in the last three years figures which demonstrate a reduction in the published results as the number of NHBC registered completions started to rise at the start of the recovery from the economic downturn. With an increase in demand for new homes and a decrease in both NHBC new home registrations and completions over the last decade the HBF Customer Satisfaction survey results published include only a snapshot of the data collected within the customer satisfaction survey of new homeowners within the UK eight weeks after legal completion. This study seeks to explore how the data collected by the NHBC is used in practice to improve the service provided to the customers, the transition of any changes into practice and the overall management of the customer satisfaction process by the builder.

THE LITERATURE

The concept of quality

Quality has long been the center of debate and for decades has focused on the improvement of the specific business rather than focusing on the customer or end user of the product. Over this period of time there have been numerous studies and work completed which have been influential in shaping the way we view quality, this includes the work of Shewhart (1931), Feigenbaum (1983), Crosby (1984), Juran (1989), Deming (1986), and Taguchi (1986). The two most influential include the work of Deming and Juran, Deming (1986) proposed that quality can only be defined in terms of customer satisfaction and can be achieved by a business that evolves and continuously strives to improve the service provided to their customers, furthermore he believed that management is responsible for 94% of all quality issues and stated that 'improving quality will reduce expenses while increasing productivity and market share' (Deming, 1986).

Following a comprehensive review Yi (1993) concluded quality could be measured in two ways, as a product (defects) or as a process (service provided). If quality is considered to be a product, Howard and Sheth (1969) state that "it is the buyer's cogitative state of being adequately or inadequately rewarded for the sacrifices he has undergone". If it is a process Hunt (1977) suggests that it is an evaluation rendered that the experience was at least as good as it was supposed to be, or it could be an evaluation that the chosen alternative is consistent with prior beliefs with respect to the alternative (Engel and Blackwell 1982, 501) or as Tse and Wilton (1988) suggest the consumers response to the evaluation of the perceived discrepancy between expectations and the actual performance of the product.

Prior to the introduction of quality assurance (ISO9000 & 9001), the primary measure of quality was the finished product. It is widely acknowledged and understood that good management leads to a quality product that leads to customer satisfaction; as Harris and McCaffer (2006) suggest can only be achieved if all the participants directly contribute to achieving the objectives. Forsythe (2015) states that the tone of the debate has gradually shifted from a predominantly supply-side perspective of quality, to one that increasingly aims to deliver customer value and satisfaction. This is largely because quality is seen as a significant contributor to business success by increasing market share, profits and customer equity (Kotler and Armstrong, 2013).

The customer's perception of quality includes more than the satisfaction obtained from the primary product or service, quality is delighting the customer by continuously meeting and improving upon the agreed requirements (Macdonald & Piggott 1990).

Quality in the house building sector

Historically one of the most perplexing issues facing organisations in the construction industry is their inability to become quality focused, which is resulting in a substandard product or service (Love *et al*., 1999). Throughout the last sixteen years following the findings of the Mori surveys (2000-2003), the HBF surveys (2005-to date) and the Barker Review of Housing in 2004 companies have been more focused on managing quality, as an attempt to improve their overall performance and competitiveness within the sector and thus has received a considerable amount of attention (Karna and Sorvala 2004).

Throughout this period of time numerous other academics and practitioners have researched both defects, snagging, quality and rework within the UK house building industry including Sommerville and McCosh (2006), Sommerville *et al*., (2006), Sommerville (2008) Auchterlounie (2009) and, Rotimi *et al*., (2014) with the majority of these focusing on defects in terms of numbers created. It is generally acknowledged that the number of defects at the completion or handover stage of a building appears to have a positive or negative influence on the satisfaction of the client or customer, however over the last two decades the construction industry has become obsessed with the attainment of quality through the measurement and use of defects as a proxy. This is demonstrated by Craig *et al*., (2010) whose research analysed over 199,000 defects related to technical and functional quality and established the issues and problems associated with snagging and the house-building sector.

The principles of good quality in the house-building sector are encapsulated in legislation and standards such as the Building Regulations and NHBC Standards and it must be remembered that speculative developers will not respond unless it is imposed by regulations (Watts 2007). The problem is that quality is a subjective issue and positively correlates with the overall customer satisfaction. Craig *et al* (2010) states that the customer is "perceived simply as a buyer who purchases the final product and as the "customer" they have no control over the finished product or the quality of the product". It must be noted that in the speculative house building sector the client ordinarily has no or minimal control over the basic specification of the property, the clients only input is within the finishes or the options permitted by the house builder albeit this is dependent on the stage of the build when they secured or purchased the property. The exception as suggested by Curtis (2011) is the client who is building a bespoke dwelling and is involved with the design, as they will have input at all levels.

Customer satisfaction in the house building sector

The purchase of a house is likely to be the largest single investment an individual will make (Stephenson & Carrick 2006) and the industry is facing a more informed client. Stephenson & Carrick (2006) also suggest that the industry still has a poor image, customers are becoming increasingly more aware and savvy and this has forced the industry to review the way it views the customer or home buyer. The emergence of the customer as the champion for change has increased the pressure on the construction industry to provide the higher quality and better service to satisfy customer needs and expectations (Dulaimi 2004).

Customer satisfaction can be seen as a goal or as a measurement tool in the development of construction quality (Karna and Sorvala 2004). It is generally acknowledged that the role of satisfaction is well established within the marketing literature and customer satisfaction has become an essential part of performance criteria in the construction sector, particularly house-building. The literature indicates that there is no commonly accepted method of measuring customer satisfaction in the construction industry (Torbica and Stroh 2000; 2001; Auchterlounie and Hinks 2001) and that satisfaction is a post purchase affect and its measurement is naturally reactive.

The heart of the satisfaction process is the comparison of what is expected with the product or service's performance, which Vavra (1997) describes as the confirmation or disconfirmation process. Customer satisfaction can be determined by either subjective (e.g. customer needs, emotions) or objective factors (e.g. product and service) (Oduro 2012). Numerous researchers have tested the relationship existing between customer expectation, perceived service quality and customers satisfaction and found out that, there is a strong positive correlation. (Parasuraman *et al*., 1985)

Following two decades of incessant outcry from both the government and customers for an improvement in the quality of new homes in the UK and as a result of the findings of the Mori/HBF surveys (2000- 2003) and the Barker Review of housing in 2004 the HBF in partnership with the NHBC introduced a national survey of house builders, which launched in 2005 as a self-completion survey to the purchasers of new build homes at both eight weeks and nine months after legal completion.

The results were first reported in 2006 and consisted of eight questions, a further ten questions were added in 2013 and one in 2014 making a more comprehensive survey. The first eight questions collated data on how satisfied or dissatisfied the home owner was with the service provided during the buying process, completing on time, the condition of the home on the day the purchaser moved in, the standard of finish, the after service provided, problems (i.e. snags, defects) including the number of problems and if they were in line with the expectations of the new home owner. The final two questions were taking everything into account, overall how satisfied or dissatisfied is the homeowner with the quality of their home and would they recommend the builder to a friend which culminate in the developer receiving a star rating (1-5). The statistics published in 2016 included a further question that asked the customer to rate on a scale of one to ten how likely they would be to recommend the builder to a friend (net promoter score, which has three categories Promoter, neutral and detractor) which in the first year shows that only 47% of the customers are considered to be promoters who would recommend the builder to a friend, the others are neutral or detractors.

The published results of the returned NHBC house builder's eight-week surveys for the "levels of quality" and "service provided" can be seen in figure 1. Initial analysis of the published results indicates that there has been a steady improvement across the sector as commanded by Barker. Further analysis taking into account all the four aspects that determine the "quality of a home" see an upward trend in customers reporting defects or snagging rising significantly until 2009, the "quality of the finish", "condition of the new home" and "quality of the new home" demonstrate a downward trend, all significantly reducing until 2006 and then fluctuated for a three year period until a sharp improvement in 2010 which was throughout the years when a significantly lower number of homes were completed and registered with the NHBC. This comes as no surprise as the number of registrations was significantly lower than

numbers seen in previous year as the number of completions and registrations increase the over quality levels are reducing and the overall defects and snagging are increasing.

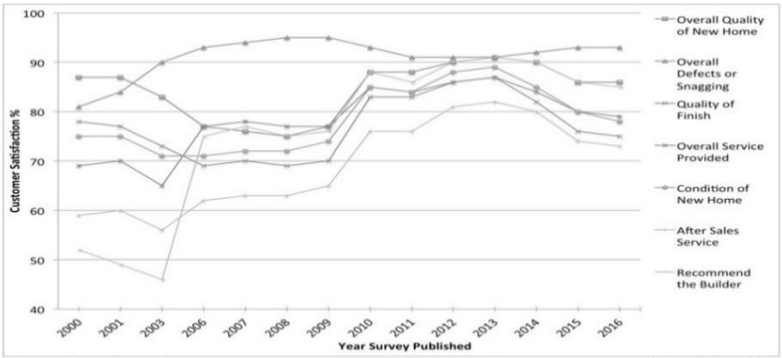


Figure 1: Levels of quality & service provided 2000-2016 (adapted from Constructing Excellence 2000, 2001, 2003 and the HBF 2006-2016).

Barker called for an improvement in the service quality provided to the customers by the developers, figure 1 plots the results collected and reported by the NHBC. It was expected from the launch date that the overall "service quality" would significantly improve and rise from 65% to at least 85% by 2007. The target of 85% was not met until 2010 for the "overall service provided" and has still to be met for the "after sales service" the builders provide to their customers, which both demonstrate a downward trend as the number of NHBC registration and completions rise. Heath's (2014) findings following "The Barker review" a decade on state that all the three levels highlighted within the Barker's review are still to be achieved and the last decade may have been a lost one in terms of the service quality provided to the customers.

The literature reveals that the construction industry and specifically the housing market predominately concentrate on defects as an indication of quality when considering customer satisfaction. Albeit the HBF/NHBC customer satisfaction completed over the past decade demonstrate that the house-building sector met some of the improvements commanded by Barker however there are other improvements that have still to be met. None of the academic or practice lead research undertaken to date has explored how the data collected by the NHBC is used in practice to improve the service provided to the customers, the transition of any changes into practice or the overall management of the customer satisfaction process by the builder.

RESEARCH APPROACH

The research reported in this paper sought to explore how the data collected by the NHBC is used in practice by speculative house builders to (i) improve the service provided to the customers (ii) the transition of any changes into practice resulting from the data received following the satisfaction surveys and (iii) the overall management of the customer satisfaction process by the house builder(s). To meet the objectives of the study, a qualitative research approach was implemented with semi-structured interviews used to collect data from all sizes of developers within the North West of England (small, medium and large). This approach is supported by Creswell (2009) who states that it is an unfolding model that occurs in a natural setting that enables the researcher to develop a level of detail from high involvement in the actual experiences, allowing the researchers to gather data for the social phenomenon being investigated from the participant's viewpoint (a Phenomenological Study).

To ensure reliability with the data collection the interview sample was selected using 'discriminate sampling' to maximise the chances of collecting relevant data from a small sample. A total of ten developers/house builders (selected from "Buildings" top 25 list of house builders) were identified within the North West (NW) of England who have been awarded a star rating and have been included within the results of all the HBF customer satisfaction surveys published to date (2003–2016). The criteria for the size of the house builder is based on the total number of units built per annum with the small <500, Medium >500 but < 2500 and the large builder >2501 units per year. Initially emails were sent to the top ten NW house builders outlining the purpose and background of the study and asking them if they would be willing to participate prior to sending the finally invitation. A total of (3) companies and (8) individuals agreed to participate in the study (see table 1).

Table 1: Interview Participant Profile

Respondent	Role	Type of organisation
A	Managing Director	Large Developer
B	Contracts Manager	Large Developer
C	Site Manager	Large Developer
D	Managing Director	Medium Developer
E	Contracts Manager	Medium Developer
F	Site Manager	Medium Developer
G	Managing Director	Small Developer
H	Site Manager	Small Developer

Each participant was invited to take part in a 20 - 30 minute interview, held at his or her offices between October 2014 and April 2015. The interviews were transcribed then analysed using Nvivo qualitative software, allowing the researcher to arrange the data using a hierarchical tree structure. The central phenomena (customer satisfaction) formed the root of the tree, from which sub-categories or nodes were generated based on a theoretical framework developed from the researchers' previous analysis of the NHBC customer satisfaction surveys. The analysis used open coding to identify the various sub-categories associated with the three central themes.

RESULTS

NHBC Data; How is it used to improve the service provided to the client?

The initial area explored during the interviews sought to determine how the information collected in the HBF nine-week customer satisfaction survey is used by the builders to improve their service provide to the customer.

The large and medium size developers indicated that the published results are a good way to benchmark their own company against the competitors; the data revealed that the builders only concentrate on the seven areas that make up the quality and the service provided elements of the satisfaction questionnaire (see figure 1). All interviewees agreed that customer satisfaction is unequivocally a necessity of any business albeit it is time consuming and costs a considerable amount of money.

The interviews revealed that the large builder concentrates on maintaining the high satisfaction level for the "recommend the builder" and the "overall quality" to ensure that they retain a high star rating, when asked why the interviewee opined;

> …a good star rating in the customers eyes is a sign of quality, it sells houses, it's like a hotel rating system the higher the stars rating the better the perceived service and quality of the hotel. Ultimately it's good for marketing the company (Managing Director A).

When further questioned if they have any data to support the statement they stated;

> …we have seen a rise in sales since we have had a four star rating and hope that we will continue to see the same upward trend after we are awarded a five star rating (Managing Director A).

The medium size builder is very customer focused, unlike the large builder, the company concentrates not on the results of one or two questions, but they consider all the data as valuable for future business development as they are striving to continually improve quality and the service provided to their customers by;

> …building on their past results and developments to improve the next and concentrate on managing the customers' expectations rather than relying on the overall satisfaction of the customer, based on the results of the eight week HBF survey (Managing Director D).

The small builder disregards the results of the HBF satisfaction surveys considering them as irrelevant stating;

> …to us a true measure of the level of a customer's satisfaction is repeat business or a good relationship throughout the building process, providing a home that meets the needs and expectations of the customer. A good reputation is more important to us as a small family business and it sells houses (Managing Director G).

Changes into practice

The next area reconnoitred through the interviews sought to establish how the builders implement any changes highlighted by their results of the HBF customer satisfaction surveys to improve either the quality of the finished home, the service provided and or the overall satisfaction of their customers. Once again the interviews revealed that both the large and medium builders implement changes to improve the results. The managing directors & contract managers agree that they restrict the extras allowed depending on the stage of the build for each property. They have a consensus of opinion that the extras permitted within the property is dependent on the base specification of the property as some levels of finish don't allow certain extras, for example the entry level property has a minimal number of allowable extras;

> …if a bath is from the budget range, of a poor quality it flexes so much that we only fit a shower curtain and therefore do not offer a shower screen upgrade due to the number of reports of it leaking as we cannot get a seal between the bath and the shower screen, therefore we no longer offer this as an option which improves the overall satisfaction of the customer (Contracts Manager, Large Builder B).

Managing the customer satisfaction process

The final area explored during the interviews revealed that the large developer is more customer focussed and commercially aware of the importance of customer satisfaction and the future sales therefore are very proactive in contacting the client a number of times over the first two - three weeks through there dedicated customer services department.

> our customer care team contact the client seven and fourteen days after legal completion to see if they are experiencing any problems or issue since they moved in enquiring and …if the site manager has completed the minor issues and scheduled for the others outstanding issues or defects to be completed, at six weeks they are contacted again and the process is repeated if required (Managing Director A).

They compete with the other regional offices within their company in relation to the satisfaction level achieved as measured by an independent company who contact the customers by telephone to carry out a satisfaction survey approximately six weeks after legal completion. The results are immediately sent to the builder, any

outstanding issues are highlighted, the builder receives a score (between one and ten), to indicate if they are a promoter (>7) or a detractor (<7) if a detractor or any issues are outstanding the builder will contact the home owner to resolve any outstanding defects or issues prior to receipt of the eight week HBF survey.

The medium sized developer is not proactive in the follow up service they provide and they are much more reliant on site staff to rectify issues. They employ the same external company to complete a satisfaction survey providing them with a similar data set as the large builder, which acts as a trigger point to complete any outstanding issues or defects if not already complete however;

> …when eight weeks after legal completion has passed we are not proactive in resolving any outstanding issues, as it's too late to affect the survey results so we concentrate on the properties that still may receive the survey (Managing Director D).

The interviews further revealed that both the large and medium builders offer a range of incentives to the staff if they (i) retain or improve on the HBF star rating, (ii) the overall HBF results relating to the customer satisfaction improve on the previous year or (iii) the development is completed ahead of programme. The builders urge the customer facing staff to actively encourage customers to complete the HBF satisfaction survey, canvassing the customer in relation to the importance of a favourable outcome for the "recommend the builder to a friend" question.

CONCLUSIONS

This paper sought to explore how the data collected by the NHBC is used in practice to (i) improve the service provided to the customers, (ii) the transition of any changes into practice and (iii) the overall management of the customer satisfaction process by the builder. The literature revealed that the HBF customer satisfaction survey results demonstrate that the house-building sector has met some of the improvements commanded by Barker but still need to meet the others. The results published by the HBF neglect to look at the long-term satisfaction of the customer, due to the published statistics and figures being solely based on the eight week satisfaction survey.

The analysis of the exploratory data provided through the interviews with the developers revealed a gap between the published statistics and current practice and further suggest the surveys are unlikely to reflect the true experiences and opinions of the customer. It furthermore suggests that as a result of the in-house survey instructed by the developers can influence the results of the HBF eight-week customer satisfaction survey as the customers are contacted at key stages prior to the receipt of the eight week survey, thus causing a bias in the market. The large and medium builders appear to concentrate on the on the customer satisfaction surveys and particularly the star rating which is seen simply as a marketing tool, used by the builders marketing department as a sign of quality and a way to promote the company.

The star rating awarded to the builder is based on two questions and are calculated using a limited number of the actual completed unit by the particular builder in the any year awarded. The question introduced in the 2014 which rates on a scale of 1-10 and asks how likely would you be to recommend your builder to a friend, when considering the results in the first published year its reported that only 47% are home owners are considered as promoters and 53% either detractors or neutral, which does not reflect the figure of 85% reported for the "recommend your builder to a friend" question for the same year (2015) published in 2016.

For the star rating to be more realistic rating a larger number of returned surveys should be included within the calculation of this award and the it should also include a wider range of questions to include all the questions (figure 1) that make up quality and service provided aspects of the HBF eight week questionnaire, thus providing a more robust system for awarding the star rating which in turn would improve the over quality and the service provided to the customer as commanded by Barker and would also be a better reflection of quality and guide for future home buyers in the UK. While the surveys appear to be selective in their approach this is a snapshot of the customer satisfaction in the NW of England and is not representative of the whole house-building sector within the UK. The next stage is to carry out further research to establish if this is a true reflection of the house-building sector within the UK.

REFERENCES

Auchterlounie, T (2009) Recurring quality issues in the UK private house building industry. *Structural Survey*, **27**(3), 241- 251.

Auchterlounie, A and Hinks, J (2001) *Assessing Customer Criteria for Quality in New Housing*. First Post-Graduate Research Conference, University of Salford, Manchester.

Barker, K (2004) *Review of Housing Supply*. Norwich: Her Majesty's Stationery Office.

Curtis, M D (2011), *New House Owners' Satisfaction Survey 2011*. Building Research Levy, Wellington.

Craig, N Sommerville, J and Auchterlounie, A (2010) Customer satisfaction and snagging in the UK private house building sector. *In*: C Egbu (Ed.) *Proceedings 26th Annual ARCOM Conference*, 6-8 September 2010, Leeds, *UK*. Association of Researchers in Construction Management, Vol. 2, 1199–208.

Creswell, J W (2009*) Research Design: Qualitative, Quantitative and Mixed Method Approaches 3edition*. London: Sage Publications.

Crosby, P B (1984) *Quality without Tears*. USA: McGraw Hill.

Deming, W E (1986) *Out of the Crisis*. Cambridge: MIT/CAES Press.

Dulaimi, M, F (2004) *The Challenge Of Customer Orientation in the Construction Industry*. Construction Innovation, **5**(1), 3-12.

Feigenbaum, A V (1983) *Total Quality Control 3rd Edition*. New York: McGraw Hill.

Forsythe, P (2015) Monitoring customer perceived service quality and satisfaction during the construction process. *Construction Economics and Building*, **15**(1), 19-42.

Harris, F and McCaffer, R (2006) *Modern Construction Management 6th Edition*. London: Blackwell Scientific Publications.

Home Builders Federation (2006-16) *New Home Customer Satisfaction*. Home Builders Federation, London.

Home Builders Federation (2014a) *Barker Review: A decade on*. Home Builders Federation, London.

Housing Forum (2000-2003) *National Customer Satisfaction Survey*. Constructing Excellence, London.

Howard, J A, Sheth, J N (1969) *The Theory of Buyer Behaviour*. London: Wiley.

Gann, D, Biffen, M, Connaughton, J, Dacey, T, Hill, A, Moseley, R, and Young, C (1998) *Flexibility and Choice in Housing*. Bristol: Policy Press.

Juran, J M (1989) *On Leadership for Quality*. New York: Jossey Bass

Karna, S and Sorvala, V (2004) *Factor-Specific Approach to Customer Satisfaction with Construction*, CIB W55/65CIB, Rome.

Kotler, P and Armstrong, G (2013) *Principles of Marketing 15th Edition.* Harlow, Essex: Pearson.

Love, P E D, Mandal, L P and Li, H (1999) Determining the causal structure of rework influences in construction. *Construction Management and Economics*, **17**(4), 505-517.

Macdonald, J and Piggott, J (1990) *Global Quality: The New Management Culture*. London, Mercury Books.

Mitchell, V W (1993) Handling consumer complaint information: Why and how? *Management Decision*, **31**(3), 21-28.

Oduro, R (2012) Factors that determine customer satisfaction level in banking institutions: Evidence from Ghanaian banking industry. *Asian Journal of Business and Management Sciences*, 2(7), 1-13.

Parasuraman, A, Zeithaml, V A and Berry, L L (1985) A conceptual model of service quality and its implications for future research. *The Journal of Marketing*, 41-50

Rotimi, F E, Tookey, J E and Rotimi, J O B (2015) Home owners and developers' relationships: Exploring the cordiality factor. *Structural Survey*, **33**(3), 278-292.

Sommerville, J (2008), *Homebuilding Market Study*. Office of Fair Trading.

Sommerville, J, Craig, N and Ambler, V (2006), Functional and technical quality in new homes in the UK: the snagging problem. Paper presented *Royal Institution of Chartered Surveyors Annual COBRA Conference*, 7-8 September, University College, London.

Sommerville, J and McCosh, J (2006) Defects in new homes: An analysis of data on 1696 new UK houses. *Journal of Structural Survey*, **24**(1), 6-21.

Stephenson, P and Carrick, C J (2006) Select and accept a new build home: Buyers' experiences, expectations and attitudes. *In*: H Smyth (Ed.) *Royal Institution of Chartered Surveyors Annual COBRA Conference*, 7-8 September, University College. London: RICS.

Shewhart, W A (1931) *Economic Control of Quality of Manufactured Product 509.* ASQ Quality Press.

Taguchi, G (1986) *Introduction to Quality Engineering*. Tokyo: Asian Productivity Organisation.

Torbica, Z M and Stroh, R C (2000) HOMBSAT: An instrument for measuring home buyer satisfaction. *Quality Management Journal*, **7**(4), 32-44.

Tse, D K and Wilton, P C (1988) Models of Consumer Satisfaction Formation: An Extension. *Journal of Marketing Research*, **25**(May), 204-12.

Vavra, T G (1997) Improving your measurement of customer satisfaction: A guide to creating, conducting, analyzing, and reporting customer satisfaction measurement programs. Milwaukee, WI: Society of Automotive Engineers.

Watts, G (2007) *The Callcut Review of House Building Delivery*. London: Construction Industry Council

Yi, Y (1991) A critical review of consumer satisfaction. *In*: V A Zeithaml (Ed.) (1989) *Review of Marketing 1989*. Chicago: American Marketing Organisation.

ASSESSMENT ON REWORK COSTS PROBABILITY OF HOUSING PROJECTS IN SRI LANKA

Budhwin Dahanayake[1], Thanuja Ramachandra[2] and Niraj Thurairajah[3]

[1&2] *Department of Building Economics, University of Moratuwa, Bandaranayake Mawatha, Katubedda, Moratuwa, 10400, Sri Lanka*

[3] *School of the Built Environment, Birmingham City University, Millennium Point, Birmingham, West Midlands, B4 7XG, UK*

Rework or rectification is a common phenomenon as well as a norm in the construction industry. It is recognized as an unnecessary effort of redoing an activity that was incorrectly implemented at the first time. This research is motivated by the increased attention given to the significant impact that rework costs have on cost performance. Therefore, the research investigates the rework costs involved in rectifying the defects and thereby develop a rework costs probability model for housing projects in Sri Lanka. A questionnaire survey was carried out together with a detailed analysis of documents. Statistical methods for eliciting probability distributions were used to analyse the data collected from 47 housing. Results of the non-parametric test; goodness-of-fit tests, revealed that generalized exponential distribution provided the best fit for the dataset. Findings of the study indicates 36 different types of more likely to occur in housing projects in Sri Lanka. On average the total rework cost as a percentage of cumulative work done value is found to be 0.92% in housing projects. Finally, the research proposes to use the developed probability model for rework costs to enable construction practitioners a quantitative risk assessment and competitive advantage in the cost performance.

Keywords: housing projects, probability, rework cost, Sri Lanka

INTRODUCTION

Rework refers to non-achievement of quality standards within the construction industry. Rework as defined by Love and Li (2000) as the unnecessary effort of re-doing a process or activity that was incorrectly implemented the first time. The impact of rework on construction organisation is significant. It can adversely affect an individuals', organisations' and project's performance and productivity (Love 2002). Abdul-Rahman (1995) agrees that an organisation's reputation and its profit margin can be affected because the cost of redoing a project that is not up to standard is high. The need to reduce costs and at the same time improve quality standards is mutually supportive for any project. If the building process must achieve the principle of doing things right the first time and every time, it should be appreciated that the occurrence of defects has a price.

To perform rational defect prevention, it is necessary to have knowledge about defects, their causes and associated costs (Josephson 1999). Mills, Love and Williams (2009) have revealed that the rework cost could be result as 0.4 % to as high as 26 % of the contract value. For example, a study by Burati, Farrington and Ledbetter

[1] bmdahana@gmail.com

Dahanayake, B, Ramachandra, T and Thurairajah, N (2016) Assessment on Rework Costs Probability of Housing Projects in Sri Lanka. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference*, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 1265-1273.

(1992) in the UK revealed that the cost of defect rectification varies between 0.4% and 26.0 % of total project costs resulting in an average cost of 12.4 %. In a similar vein, Rhodes and Smallwood (2002) estimated the cost of rework in a construction project in South Africa to be 13% of the value of the completed construction. Another research in the UK, Egan (1998) reported that up to 30% of construction work is related to rework while in the USA the annual loss due to rework could be as high as US$15 billion for industrial construction.

With this notion in mind, the objectives of the research are to;

- Identify significant defects according to its frequency which aroused rework
- Identify the cost impact of defects against frequency of occurrence
- Analyse the rework probability

The research identifies frequency of defects, probability of rework costs for rectification of defects of residential buildings in the course of construction and defect liability period. For the purposes of this research, rework is defined as 'the unnecessary effort of redoing a process or activity that was incorrectly implemented at the first time'.

Rework and defects

The term 'defect' has been defined differently by researchers. It means the shortcomings in the design and construction practices for some of them, while to others; it implies the inadequacies that arise from normal wear and tear. Olanrewaju and Idrus (2010) indicate that design and construction defects are those that are caused due to wrong methods of construction, poor materials and bad labour practices. "A defect is a shortfall in performance occurring at any time in the life of the product, element or building in which it occurs (BRE Digest 268). It is also a departure from design requirements where these were not themselves at fault" (Douglas and Ransom 2013: 49). However, Table 1 shows that there has been recent increase in research on defects in the house building sector.

Another term that is commonly used is rework. Rework may be defined as the process by which an item is made to conform to the original requirement by completion or correction (Ashford 1992). Alternatively, rework is doing something at least one extra time due to non-conformance to requirements (Construction Industry Development Agency 1995). A broader definition of rework is unnecessary effort of redoing a process or activity that was incorrectly done the first time (Love and Edwards 2004). However, Hwang, Thomas, Haas, and Caldas (2009) emphasis that all these definitions share a common theme which is to redo work due to non-conformance with requirements or the occurrence of a defect.

RESEARCH METHODOLOGY

A quantitative approach was used as the main research approach to obtain the frequency of defect occurrence and observe the behaviour of the total rework costs associated with defects. A questionnaire survey along with document survey was implemented to improve the reliability of the data obtained. The questionnaire had four major focuses: general profile of the project which had defects, types of defects together with their frequency and rework costs associated with them. The respondents were asked to consider their experience in projects where they had defects and answer the questions given under the above four areas. In addition, participants were given

the list of defects identified in the literature. Where it deviates from the literature findings participants were given the freedom to indicate their own options.

Table 1: Definitions of defects in various contexts (Rotimi 2013: 89)

Context of definition	Definition	Literature Sources
Wider construction environment	Wider construction environment	BRE (1990)
Wider construction	Non-fulfilment of intended usage environment requirements	Josephson and Hammarlund (1999)
House building environment	Failing or shortcoming in function, performance, statutory or user requirements of a building that manifests itself within the structure, fabric services and other facilities of the building.	Ilozor, et al. (2004)
House building environment	A final product that does not meet the required quality.	Kim, et al (2007)
House building environment	A component has a shortcoming and no longer fulfils its intended function.	Georgiou (2010)
House building environment	Breach of any mandatory requirement by builder or anyone employed by or acting for the builder.	NHBC (2011)
House building environment	Something that is unfinished, or an imperfection that is inadequate or causes failure.	Beattie (2011)

The study sample was selected based on snowball sampling method as there was tendency of the participants were reluctant to furnish some of the confidential information. The respondents based on their professions can be shown as follows; Projects Manager (24%), Quantity Surveyor (36%), Site Engineer (20%), Assistant Site Engineer (8%), Quality Assurance Engineer (4%), Assistant Manager, Costing (4%) and Chief Engineer (4%). The research participants had 5 to 20 years of work experiences in building construction sector. For the data analysis, details were obtained from building projects situated in Western and Southern provinces carried out by different contractors.

Data were collected from construction firms which have C3 to C7 grading and registered with Construction Industry Development Authority (CIDA) in Sri Lanka. Altogether 100 questionnaires were distributed among the potential respondents and 56 were returned resulting a response rate of 56%. During the data collection, a detailed questionnaire along with a semi-structured and open ended questions were included to improve the reliability of the data. The received questionnaires were undergone through a screening test in order to see whether the questionnaires were consisted with relevant and appropriate data for being used in data analysis. After the screening test 3 questionnaires were rejected due to lacking consistency and inappropriate data. After the screening process, a thorough document survey has been carried out as a reliability measure. It has been carried out by reviewing their actual rework costs records with the research participants in their workplaces in order to identify the level and standard of their rework costs recording procedures. After completing the document survey, another 6 questionnaires were dropped down as they have 4 of the research participants have refused to expose their cost records and other 2 due to low standards of rework costs records.

Quantitative data collected from the questionnaire and document survey where required were encoded using the Statistical Package for the Social Science (SPSS) v.20 and results were analysed using both descriptive and inferential statistics. Additionally, EasyFit Professional 5.6 were used to analyse the probability of distribution of rework costs.

RESEARCH FINDINGS AND DISCUSSION

Frequency of defects occurrence

Total of 47 questionnaires have been received from the building type of housing where their project amounts ranging from 2 to 20 million Sri Lankan rupees, and Figure 1 depicts the responses given by the participants to the research. When considering the frequency of occurrence, defects which had not less than 5 occurrences, honeycombs, bulging of beams, level issues of slabs, bulging of columns, verticality issues of walls, plaster cracks, foundation defects, fading of paint and roof defects can be identified.

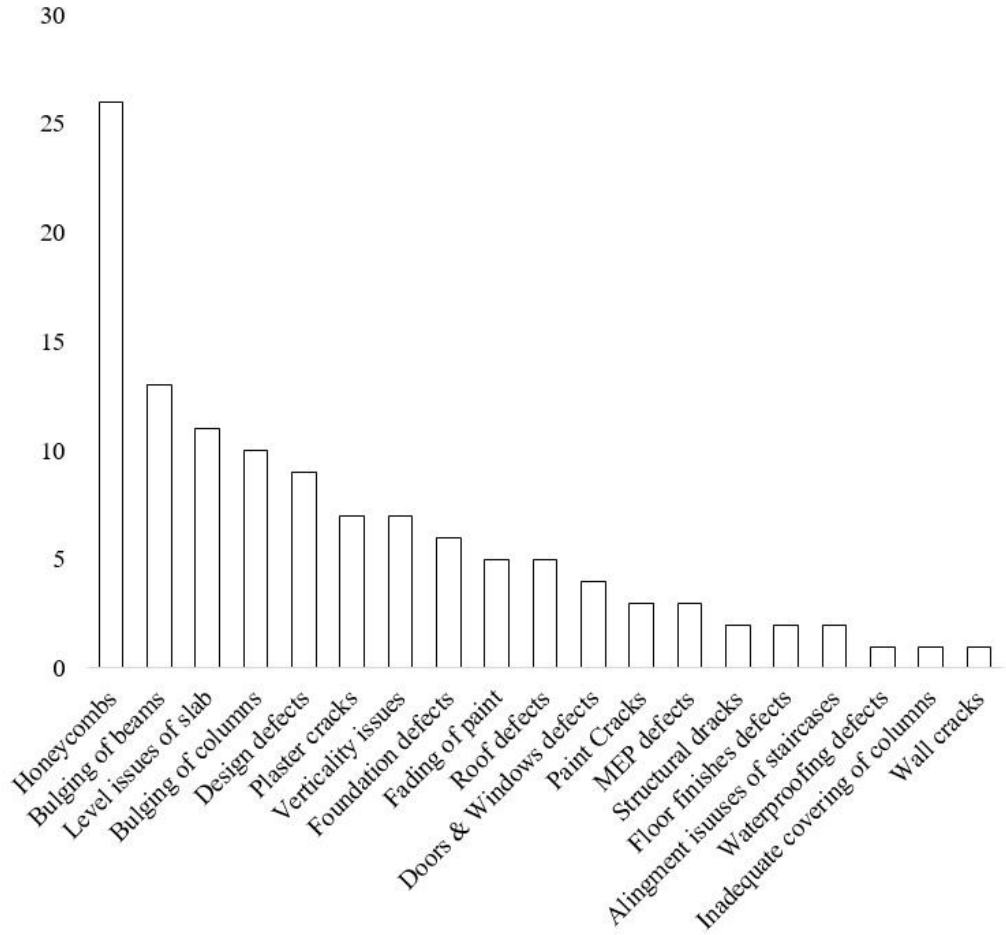


Figure 1: Frequency of occurrence

Honeycombs being the first in the ranking, are recognised as an unavoidable defect by the respondents. Due to this reason, some of them are not willing to admit it as a defect rather than a natural incident in the construction other than any major or severe honeycombs occurred, for instance honeycombs which arise into a deficiency in structural strength. As shown in Figure 2, frequency of defects and the impact on the total rectification/ rework cost by the defects can be analysed. The impact has been

captured in accordance with the data provided by the respondents, and each rework/ rectification cost pertaining to a particular defect has been inserted into the questionnaire Likert scale by considering the respective percentage.

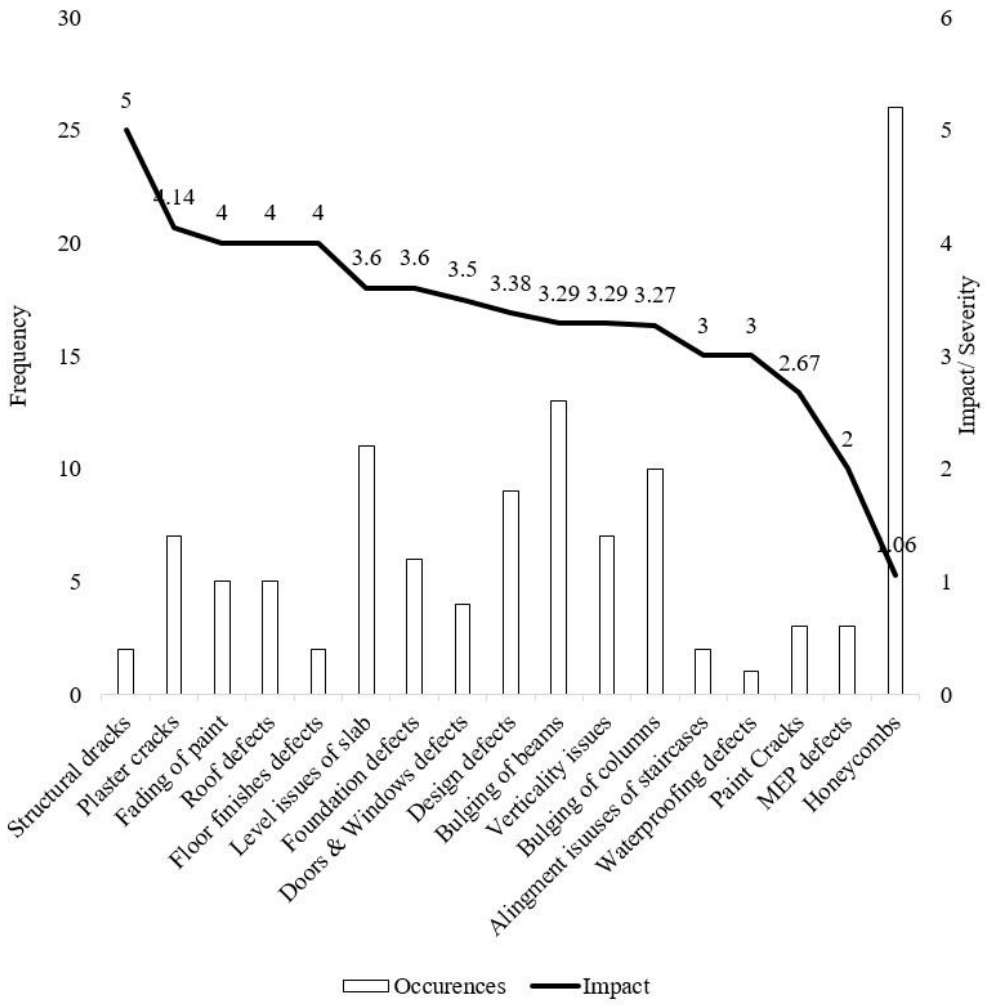


Figure 2: Impact on total rectification costs of defects

Subsequently, mean of Likert scale values graphed against the frequency to derive the Figure 2. It has to be noted that though honeycombs being the highest frequent defect among the defects, when considering the impact on the rectification costs it has scored the last. This graph depicts the defects which are of more significant in terms of cost irrespective of the frequency.

Rework costs

Table 2 presents the descriptive statistics for the total rework costs used in determining the probability of rework in the sampled project. The mean total rework cost as a percentage of the original contract sum was revealed to be 0.91% and the standard deviation was 0.86%. The data indicate that the total rework costs ranged from 0.05% to 3.7%. Evidently, the total costs of rework vary considerably among projects. It has been argued that the degree of variability in the estimates specified by the respondents suggests that many respondents may be unsure about the actual costs of rework incurred in the projects (Love 2002).

The following steps were adopted to determine the probability of rework. First, the probability density functions (PDFs) were developed using EasyFit Professional 5.6 software. The PDF is a mathematical expression that analyses a continuous random variable and defines the shape of the distribution. The 'best fit' probability distribution was examined using Kolmogorov-Smirnov and Anderson-Darling goodness-of-fit tests.

Table 2: Descriptive statistics of total rework costs

Statistic	Value	Percentile	Value
Sample Size	47	Min	0.049
Range	3.646	5%	0.0956
Mean	0.92	10%	0.122
Variance	0.74	25% (Q1)	0.583
Std. Deviation	0.86	50% (Q2)	0.583
Coeff. of Variation	0.94	75% (Q3)	1.292
Std. Error	0.13	90%	2.229
Skewness	1.32	95%	2.766
Excess Kurtosis	1.34	Max	3.695

Kolmogorov-Smirnov statistic (D): Based on the largest vertical difference between the theoretical and empirical CDF (Cumulative Distribution Function). Anderson-Darling statistic (A2): A general test to compare the fit of an observed CDF to an expected CDF. The test provides more weight to distributions tails than the Kolmogorov-Smirnov test. As observed from Table 3, the results of the goodness-of-fit tests revealed that generalised Exponential distribution provided the best fit for the dataset for total rework costs.

Table 3: Goodness-of-fit details for total rework costs

Kolmogorov-Smirnov					
Sample Size	47				
Statistic	0.072				
P-Value	0.953				
Rank	3				
α	0.2	0.1	0.05	0.02	0.01
Critical Value	0.153	0.175	0.194	0.217	0.233
Reject?	No	No	No	No	No

Anderson-Darling					
Sample Size	47				
Statistic	0.072				
P-Value	0.953				
Rank	3				
α	0.2	0.1	0.05	0.02	0.01
Critical Value	0.153	0.175	0.194	0.217	0.233
Reject?	No	No	No	No	No

The histogram presented in Figure 4, depicts probability distribution function for rework costs based upon the distribution parameters. For instance, Figure 4 shows that likelihood that a project will exceed a mean total rework cost of 0.92% is 37%.

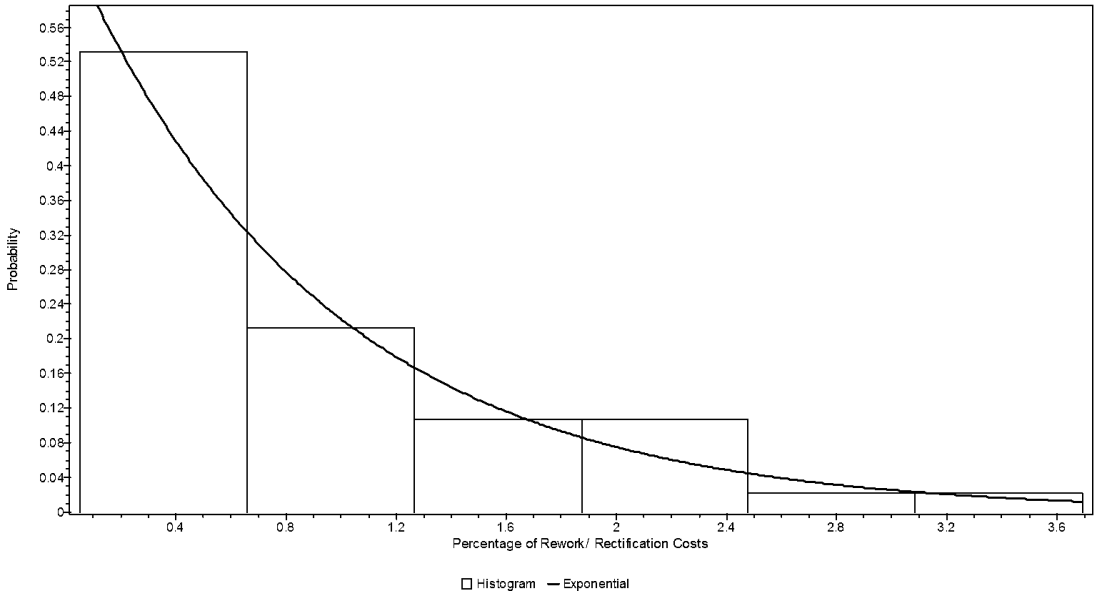


Figure 4: An exponential histogram of rework

DISCUSSION

Previous research studies done in several countries such as United Kingdom, United States of America, South Africa, etc. the rework costs have been turned out to be ranging from 0.4% to 30% of the project sum. In contrast to that this research has revealed that rework cost of house construction projects in Sri Lanka is being ranging from 0.5% to 3.7% of the project sum. Likelihood model of the rework cost has been developed in this research so it can be interpreted to see whether how much risk is involved against the project sum. For instance, when a domestic contractor is in the bidding process for a housing project, that contractor can use this probability model to determine the risk factor for rework over the others who may use other general high figure. In that scenario, knowing that the rework percentage is low when it comes to risk allowance in bidding for house construction projects in Sri Lanka, is a big advantage which can be drawn out from the probability model introduced in this research. As well, this research reveals the cost significance of defects against its frequency of occurrence, which may ultimately be focussed towards quality control of construction.

CONCLUSIONS

The research presented the types of defects and its frequency of occurrence during the course of construction and throughout the defect liability period. Required data from 47 housing projects were obtained through questionnaire survey along with interviews and document survey.

Research has uncovered most occurring defects types during construction and throughout the defect liability period. Considering the findings presented in this research, approximately 54% of the defects have been recorded in the concrete works during the structure construction. Most of the roof defects are due to water leakages and they were only reported within the defect liability period. As an overview, contribution factors for defects have been identified as lack of supervision, unfavourable working conditions, design errors, poor coordination of works, construction materials and poor workmanship. However, it was revealed that there was a lacking procedure in documentation and proper management of defects of most of the sites from the interviews conducted. As identified in the research, organizational practices have more influence on this aspect, as being some have established quality objectives to control defects and some have not had much consideration on defects.

The analysis of rework costs revealed that, the total rework costs as a percentage of the total work done value varies from 0.5% to 3.7%. During the statistical analysis, using Kolmogorov-Smirnov statistic and Anderson-Darling statistic, it has been observed the distribution of rework costs follows general Exponential distribution. The mean total rework cost as a percentage of the cumulative work done value was found to be 0.92%. For a mean total rework cost of 0.92%, the likelihood that a project exceeds is 37%.

REFERENCES

Abdul-Rahman, H (1995) The cost of non-conformance during a highway project: A case study. *Construction Management and Economics*, **13**(1), 2332.

Ashford, J L (1992) *The Management of Quality In Construction*. London: E & FN Spon.

Burati, J L, Farrington, J J and Ledbetter, W B (1992) Causes of quality deviations in design and construction. *Construction Engineering and Management*, **118**(1), 34-49.

Construction Industry Development Agency (1995) *Measuring Up or Muddling Through: Best Practice in the Australian Non-Residential Construction Industry*. Sydney, Australia: CIDA/Masters Builders.

Douglas, J and Ransom, B (2013) *Understanding Building Failures 4th Edition*. Oxon: Routledge.

Egan, J (1998) *Rethinking Construction, The Report Of The Construction Task Force*. HMSO: Norwich.

Hwang, B G, Thomas, S R, Haas, C T and Caldas, C H (2009) Measuring the impact of rework on construction cost performance. *Construction Engineering and Management*, **135**(3), 187-198.

Josephson, P E (1999) The causes and costs of defects in construction: A study of seven building projects. *Automation in Construction*, **8**(6), 681–687.

Love, P E D (2002) Auditing the indirect consequences of rework in construction: A case based approach. *Managerial Auditing Journal*, 138-146.

Love, P E D and Edwards, D J (2004) A rework model for construction projects. *IEEE Transactions on Engineering Management*, **51**(4), 426-440.

Love, P E D and Li, H (2000) Overcoming the problems associated with quality certification. *Construction Management & Economics*, **18**(2), 139-149.

Mills, A, Love, P E and Williams, P (2009) Defect Costs in Residential Construction. *Journal of Construction Engineering and Management*, **135**(1), 12-16.

Olanrewaju, A L and Idrus, A (2010) Quantitative analysis of defects in Malaysian university buildings: Providers' perspective. *Journal of Retail & Leisure Property*, **9**, 137-149.

Rhodes, B and Smallwood, J J (2002,) Defects and rework in South African construction projects. *In*: *Symposium conducted at the meeting of the RIGS Foundation construction and building research conference, 5-6 September,* Nottingham Trent University: UK.

Rotimi, F E (2013) *An Evaluative Framework For Defects In New Residential Buildings: The New Zealand Case*. PhD Thesis, Auckland University of Technology: New Zealand.

INDEX OF KEYWORDS

INDEX OF AUTHORS