ARCOM

ASSOCIATION OF RESEARCHERS IN **CONSTRUCTION MANAGEMENT**

Doctoral workshop on sustainable infrastructural delivery for economic growth in Africa

WORKSHOP PROCEEDINGS

27 – 28 July 2016

Ashesi University College, Accra-Ghana

London South Bank University

ASHESI UNIVERSITY

University of Salford MANCHESTER

CONTENTS

Introduction

Sustainable infrastructural delivery in Africa is paramount if the continent is to achieve the sustainable development goals (SDGs) by 2030. Whiles infrastructure has been responsible for more than half of sub-Saharan Africa's recent improved performance in growth, Africa still suffers from a pronounced infrastructure deficit. The provision of sustainable infrastructure improves the quality of life stimulates economic growth and competitiveness. It is also essential for improving the quality of life and inclusion in modern societies (IDB, 2014). Sustainable infrastructure delivery in Africa will reduce poverty and enhance social development, economic growth, and also minimise the environmental effects of infrastructure (Doczi et al., 2013).

Bhattacharya et al. (2015) describe infrastructure as a common denominator for accelerating the sustainable development agenda toward eradicating poverty and climate change. The planning, design and construction of sustainable infrastructural delivery is essential for the creation of a healthy, happy and thriving economic climate for future generation in Africa. The focus of this ARCOM sponsored workshop is to explore the principles, management, implementation and delivery of sustainable infrastructure. The workshop seeks to provide a platform for doctoral students to share and provide empirical insights into the link between infrastructure delivery and economic growth. The workshop will address the following specific themes:

- Financing infrastructure delivery in Africa
- Public-private partnerships and infrastructure delivery
- Procuring infrastructure in Africa
- Infrastructure maintenance culture and facilities management
- Sustainable Architecture and infrastructure development
- Sustainable infrastructure and Regeneration
- Sustainable construction in developing economies
- Current and emerging infrastructure issues in Africa
- Economic growth and infrastructural development
- Sustainable Development Goals (SDGs) and infrastructure delivery
- Impact of corruption on infrastructure delivery
- Stakeholder involvement in infrastructure delivery
- Governance and Infrastructure Development

Workshop Convenors:

Dr Alex Opoku; London South Bank University
Dr Chika Udeaja; University of Salford
Dr Sena Agbodjah Agyepong, Ashesi University College

References

- Bhattacharya, A., Oppenheim, J. and Stern, N. (2015), Driving Sustainable Development through better infrastructure: Key elements of a transformation program, Global Economy & Development Working Paper 91, Washington, DC: Brookings Institution

- Doczi, J., Dorr, T., Mason, N. and Scott, A. (2013), The post-2015 delivery of universal and sustainable access to infrastructure services, Overseas Development Institute (ODI) Working paper, London: Overseas Development Institute

- IDB (2014), Sustainable infrastructure for competitiveness and inclusive growth, IDB infrastructure strategy, Washington D.C: Inter-American Development Bank (IDB

Workshop Programme

Day 1

Name	Affiliation	Topic	Time
Dr Sena Agyepong	Ashesi University College	Registration /Tea	**8:30**
Welcome Address			
Araba Botchway	Director, Admissions and Financial Aid. Ashesi University College	Welcome to Ashesi	**10:00**
Keynote Speaker:			
Dr Fred McBagonluri	Dean and Associate Professor, Engineering	Is Sustainable Infrastructure = Sustainable Development?	**10:15**
Campus Tour			
Michael Quansah	Ashesi University	Ashesi Campus Tour	**10:45**
Presentation Session 1			
Isaac Mensah	K.N.U.S.T, Ghana	Modelling construction duration: a comprehensive review of literature	**11:10**
Samuel Bewiadzi	University of Ghana, Ghana	Decentralisation, infrastructure delivery and poverty reduction in Ghana: a study of Ho Municipality in the Volta region	**11:25**
Discussions Session: **Chaired by Dr Chika Udeaja-Salford University**			**11:55**
LUNCH BREAK & NETWORKING			**12:30**
Keynote Speaker			
Dr Ambrose Dodoo	Linnaeus University, Sweden	Research Methodology for Doctoral students	**13:30**
Questions and Answers session: **Moderation by Dr. Sena Agbodjah Agyepong, Ashesi University College**			**14:15**
Break			**14:30**
Presentation Session 2			
Jonas Ekow Yankah	University of Johannesburg, South Africa	The repercussions of infrastructural delivery by non-domestic companies in developing nations	**14:45**
David Ayock Ishaya	Federal Polytechnic, Kazaure-Nigeria	Identifying Criteria for Environmental Sustainability in Housing Development in Abuja Nigeria	**15:00**
Emmanuel Bamfo-Agyei	University of Johannesburg	A Labour Output Model for block work using activity Sampling Techniques in Ghana	**15:15**
Discussion Session: **Chaired by Dr. Naa Adjeley Ashiboe-Mensah Doamekpor, Pentecost University**			**15:30**
CLOSING REMARKS – Dr Sena Agbodjah Agyepong, Ashesi University College			**16:05**
Closing			

Day 2

Name	Affiliation	Topic	Time
Dr Sena Agyepong	Ashesi University College	Registration /Tea	**08:30**
Dr Sena Agyepong	Ashesi University College	Welcome Address	**10:00**
Keynote Speaker:			
Dr Chika Udeaja	University of Salford	My PhD Experience	**10:35**
Presentation Session 1			
All participants in sub-themes		From the MDGs-to-SDGs: from the perspective of the build environment professional	**10:35**
Discussions Session: **Moderation by Dr Chika Udeaja-Salford University**			
LUNCH BREAK & NETWORKING			**12:25**
Keynote Speaker			
Kobina Graham	Ashesi University College	Communication and presentation skills for doctoral students	**13:25**
Questions and Answers session: **Moderation by Dr. Sena Agbodjah Agyepong, Ashesi University College**			**14:10**
Break			**14:25**
Presentation Session 2			
Sarfo Mensah	Kumasi Polytechnic	Barriers against contractors' adaptation to environmentally sustainable construction processes	**14:40**
Collins Ameyaw	Bauhaus University, Germany	Understanding the factors influencing private sector investment in the power generation sector of Ghana: System Dynamics Approach	**14:55**
Anita Odame	K.N.U.S.T, Kumasi-Ghana	An Investigation into Personal Protective Equipment use in the Ghanaian Construction Industry	**15:10**
Discussion Session: **Chaired by Prof. Samuel Kwame Ansah, Cape Coast Polytechnic**			**15:25**
CLOSING REMARKS – Dr Chika Udeaja-Salford University			**16:00**
Closing			

MODELLING CONSTRUCTION DURATION: A COMPREHENSIVE REVIEW OF LITERATURE

Isaac Mensah, Gabriel Nani, Theophilus Adjei-Kumi and Emmanuel Adinyira

Kwame Nkrumah University of Science and Technology

ABSTRACT

Underestimation or overestimation of the duration of construction projects has serious repercussions on the success of a project. In view of this, studies in construction duration modelling have received a considerable attention by researchers all over the world. A review of 41 articles on construction duration modelling from 21 construction management journals from 1969 to 2016 was done. Each article was classified into buildings, roads, bridges, dams and railways in addition to the statistical techniques and variables used for modelling for the purpose of synthesis and analysis. The results indicate that none of the researchers for the 41 articles used the quantities of work items in bills of quantities (BOQ) as predictors or input variables in their developed models. The analyses further showed that the railway sector has not received any attention at all when it comes to duration modelling. In addition, the results indicated that the application of the use of artificial neural network (ANN) and neurofuzzy techniques in duration modelling which researchers have determined to have high predictive abilities is minimal (5% each) as compared to the regression technique (78%). The study has identified these potential gaps for researchers and practitioners in construction duration modelling and has also provided valuable information for researchers and practitioners to appreciate the areas that have not received attention to construction duration modelling. The study finally recommends studies to be done using the work items in BOQs as predictors for the building, roads and dams sectors as well as research in duration modelling for the railway sector where no such studies have been conducted.

Keywords: Modelling, Construction duration, categorization, comprehensive literature, construction sectors.

INTRODUCTION

Predicting the duration of construction projects is necessary for the purpose of budgeting. Overestimation of construction duration leads to increased cost whiles underestimation can lead to potential revenue being lost. As a result of the problems associated with unrealistic construction duration, researchers have investigated this subject and have developed models for the purpose of predicting the duration for construction projects (see Appendix 1). The models developed by these researchers were based on regression, artificial neural network (ANN) and neurofuzzy techniques using variables that the researchers determined to have effect on the duration.

Out of the 41 articles reviewed in this study, 20 of these articles used construction cost as a predictor for modelling duration in the building, road and bridge sectors. The use of cost as a predictor has a limitation in terms of time value of money (the change in cost for the same quantum of work over a period of time). Developing a model with cost as predictors would therefore have to be regularly updated or redeveloped to enable practitioners to use the developed models for future projects. The quantities of work items in BOQs do not vary over time as compared to its cost. To resolve this limitation, it is worth considering developing models with the quantities in BOQs as input variables as such models would not require regular updates for its usage by practitioners. It has been suggested that the duration of a construction project depends more on the quantities of work items rather than its costs (Horner and Zackieh, 1993). However, none of the 41 articles reviewed in this study used the quantities of work items in BOQs as predictors or input variables for construction duration modelling. Furthermore, no research in duration modelling has been carried out in the railway sector and these represent potential gaps in the body of knowledge.

A comprehensive literature review is an important instrument for the purpose of evaluating, gathering information and identifying gaps in the body of knowledge in a research area. A search of existing literature on modelling construction duration showed that there has not been a comprehensive review on this subject. There is therefore the need for a critical appraisal or review of existing literature on modelling construction duration in order to identify potential gaps for research. The purpose of this study is to identify, harmonize and integrate the plethora of literature on modelling construction duration with the view of addressing the following questions:

1. Which statistical techniques were employed in duration modelling by researchers?
2. What variables were used in the development of the models in the published articles?

In this study, literature on modelling, estimating or predicting construction duration is classified and a comprehensive review of these studies is presented. Articles on this subject emerged as far back as 1969 first by Bromilow in Australia. This study considered articles from 1969 to 2016, a period of 47 years. It reviews 41 existing articles on this subject to ascertain the statistical techniques used in developing the models. It also considers the variables used as independent variables in the development of the models and attempts to suggest the parameters that have been neglected or overlooked by the researchers in developing such

models. Areas of the construction industry that has not witnessed duration modelling but overlooked by researchers were also considered in this study.

The paper is organized into seven sections. The first section deals with the introduction of the study whereas the second section considers review of literature. The third section elaborates the research methodology employed in the study. This is then followed by the analysis of results of the reviewed literature in section four. The fifth section deals with the summary of the findings. The sixth section mentions the limitation of the study and the seventh section with the conclusion and recommendations by identifying the gaps and suggesting areas for further research.

LITERATURE REVIEW

Though a comprehensive literature review (analysis) on existing construction duration modelling has not been carried out, a number of comprehensive reviews have been done in other areas of the construction industry. This section reviews a few of these studies.

Faturechi and Miller – Hooks (2015) carried out a comprehensive review of 200 articles on measuring the performance of transportation infrastructure systems in disasters. They classified the articles on qualitative and quantitative approaches in assessing performance. From the aggregated literature, they found that performance of infrastructure systems in disasters can be gauged under the characteristics of risks, vulnerability, reliability, robustness, flexibility, survivability and resilience.

Lu et al (2015) conducted a 15 year literature review on ICT applications in Architecture, Engineering and Construction Organizations. Using 145 articles from 12 Construction and IT related journals, they summarized and categorized development of ICT applications to date, discuss the advances and limitations of the use of ICT and finally proposed new areas for future research.

Membah and Asa (2015) also carried out a systematic comprehensive literature review of transportation tunnel projects and identified 40 cost estimation factors to address cost underestimation. They analyzed 39 articles published from 1988 to 2013 using descriptive and Anderson –Darling statistical methods. Their results showed the five top factors contributing to cost underestimation of tunnelling projects. Yi and Chan (2014) carried out a comprehensive review of literature on construction labour productivity by identifying 129

journals and provided a platform for researchers and industrial practitioners to appreciate the latest developments and trends in productivity research.

Deng and Smyth (2013) also reviewed 36 papers on contingency – based approach to firm's performance in construction. Their study revealed that the contingency – based approach is increasingly becoming visible in the construction management literature. It further revealed that 36 performance indicators are used to measure firm performance. The area of modelling construction duration has not received this attention with the view of identifying potential gaps and this paper focuses on this gap.

RESEARCH METHODS

Articles in English from the following databases; Emerald full text, Science Direct, Ingenta Connect, Taylor and Francis, American Society of Civil Engineers (ASCE), Springer and Association of Engineering, Project, and Production Management were identified. In identifying the journals which were relevant to this study, the following key words were used in the "title/abstract/keyword" field of the databases mentioned above. "Estimating duration for construction projects'', "Time –Cost Models for construction projects'', "Predicting duration for construction projects" and "Forecasting Duration for construction projects". These phrases returned a number of articles which were screened by reading the abstract and in certain instance the content of the articles. The relevant articles were then classified into buildings, roads, dams, bridges and railways for synthesis and analysis. Articles on roads were further sub –divided into highways, rural and urban roads. For the purpose of this study highways are defined as roads linking regional or district capitals whereas rural roads were those roads linking villages. The urban roads are those within municipalities and cities.

Having classified the identified literature, the independent variables used in the development of the models for duration were also grouped together including the statistical techniques, the journal that published the articles and the year of publication. The papers identified are all peer reviewed and do not include conference proceedings. The journals identified to have published these papers are as follows: *Building Forum, The Chartered Builder, Building Economist, Construction Management and Economics (CME),Highways and Transportation (HT) , Building and Environment (BE), Engineering ,Construction and Architectural Management (ECAM) among others (See Appendix A for all the selected journals used in this study).* Appendix 1 also shows the articles identified including the year and journals in which

they were published as well as the sector of construction industry in which the research was conducted. The articles identified and reviewed were analyzed and classified based on the following five dimensions:

(a) Journals
(b) Publication year
(c) Sector of construction industry and parameters used in construction duration modelling
(d) Contributions of countries
(e) Statistical Techniques

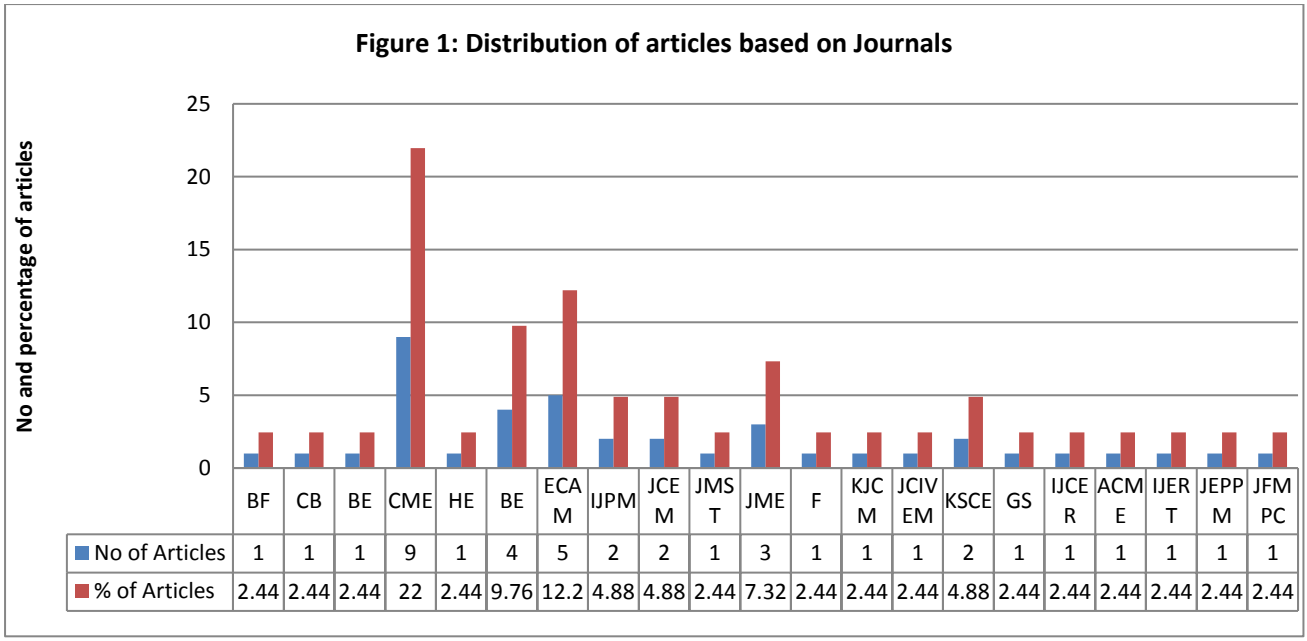
This adopted framework provides guidelines for pursuing a rigorous research and identifying potential gaps in modelling construction duration.

ANALYSIS OF CLASSIFIED ARTICLES AND DISCUSSIONS

Distribution of articles based on journals

Figure 1 shows that twenty –one (21) journals have published articles on modelling construction duration. Out of these, the Construction Management and Economics (CME) journal had by far, the largest number of articles (21.95%). This clearly indicates that this journal had contributed significantly to modelling construction duration. This was not surprising since in ranking 22 construction management journals, Wing (1997) in his study, identified CME as the construction management journal with the highest score. CME published its first paper on modelling construction duration in 1985 and the author was Ireland. In 1992, Kaka and Price also published a similar article in this same journal for building and road construction projects. This was then followed by Nkado in 1992 (see Appendix 1).

The Journal of Engineering, Construction and Architectural Management (ECAM) had the second largest number of articles (12.2%) published in the study area. Again this journal was determined to have had the third highest score in the study conducted by Wing (1997).



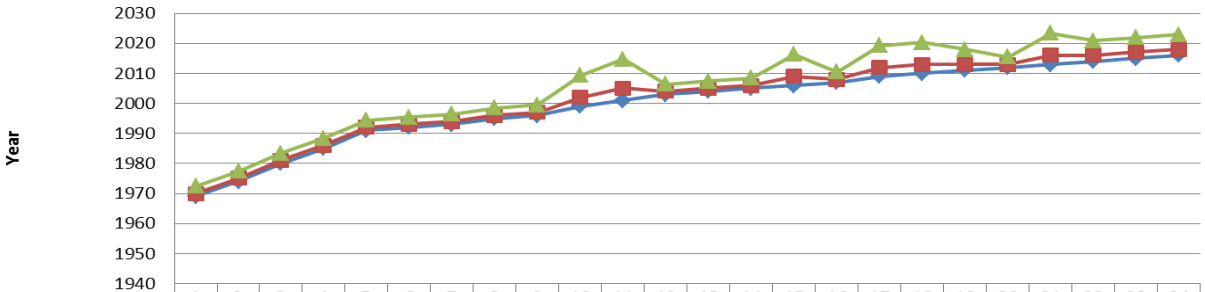
The third largest number of articles (9.76%) was published in the Building and Environment Journal. This journal focuses on building science and human interaction with the built environment and so all the identified articles published by this journal in the study area were on the building sector. The authors who published in this journal as shown in Appendix 1, were Khosrowshahi and Kaka (1996), Chan and Kumaraswamy (1999), Skitmore and Ng (2003) and Chan and Chan (2004). The fourth largest number of articles (7.32%) was published in the Journal of Management in Engineering (JME). Just like the Building and Environment journal, all the duration construction modelling articles published by this journal were on buildings. It is important to note that the JME journal recorded the fourth highest score by the respondents in the study conducted by Wing (1997).

The International Journal of Project Management (IJPM), Journal of Construction Engineering and Management (JCEM) and KSCE Journal of Civil Engineering (KSCE) each published 4.88% of the identified reviewed literature in construction duration modelling. These three journals represent the fifth largest number of articles. The remaining 14 journal articles (see figure 1) each represented 2.44% of the articles identified. The low numerical values for these journals can be attributed to the fact they barely address issues on modelling duration for the construction industry.

Distribution of articles based on year of publication

Figure 2 shows the distribution of articles from 1969 to 2016, a period of 47 years. The first publication on modelling construction duration was by Bromilow in 1969. He developed a time –cost model using construction cost as the independent variable for building projects in Australia. Bromilow further confirmed his developed model in 1974 and 1980. Thus from the period of 1969 to 1980, Bromilow was the only researcher who had conducted studies on modelling construction duration.

Figure 2: Distribution of articles based on year of publication



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
% of Articles	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	7.32	9.76	2.44	2.44	2.44	7.32	2.44	7.32	7.32	4.88	2.44	7.32	4.88	4.88	4.88
No of Articles	1	1	1	1	1	1	1	1	1	3	4	1	1	1	3	1	3	3	2	1	3	2	2	2
Year	1969	1974	1980	1985	1991	1992	1993	1995	1996	1999	2001	2003	2004	2005	2006	2007	2009	2010	2011	2012	2013	2014	2015	2016

Since the development of the time –cost model by Bromilow, other researchers have confirmed his model and have modelled construction duration from 1985 to 2016 in other parts of the world. Research in construction duration modelling increased from 2.44% in year 1996 to 7.32% and 9.76% respectively in years 1999 and 2001 (figure 2 refers). The increasing number of articles between these periods is not surprising as researchers and practitioners found the need to carry out studies to solve the problems of unrealistic contract duration in different sectors of the construction industry. Years 2009 and 2010 also recorded 7.32% each, the articles identified in these years being written by Lee - Hoi and Lee (2009) , Lee - Hoi et al (2009), Pewdum et al (2009), Mensah (2010), Jiang et al (2010) and Hammad et al (2010). As at the first quarter of 2016, two number articles representing 4.88% had already been published and these were done by Kim et a l (2016) and Jin et al (2016).

Distribution of articles based on sector of construction industry and parameters used in model development

Table 1 clearly shows the distribution of the surveyed articles based on the sector of construction industry. It is to be noted that the actual number of articles identified is 41. However, the total number of articles studied per sector as shown in table, is 43. This is because each article authored by Kaka and Price (1991), Kumaraswamy and Chan (1995) developed models for both buildings and roads. Mensah (2010) developed models for highways, rural and urban roads. It is worth mentioning that unlike other articles on roads, no specific mention of category of roads (i.e. highways, rural roads or roads in urban areas) were made by Kaka and Price (1991), Kumaraswamy and Chan (1995), Czarnigowska and Sobotka (2014) and so it was assumed in this study that the roads studied by them were highway roads. Jiang et al (2010) modelled for highway roads and bridge replacement.

Table 1: Distribution of articles based on Construction sector

Sector	**No. of articles**	**% of articles**	**No of articles studied per Sector**	**% of articles studied per Sector**
Building only	31	75.61	33*	76.74*
Building & Roads	2	4.88	-	-
Roads only:	5	12.2	7*	16.28*
- Highways	-	-	7	16.28
- Rural Roads	-	-	1	2.33
- Urban Roads	-	-	1	2.33
Bridges only	1	2.44	2*	4.65*
Bridges & Roads	1	2.44	-	-
Dams	1	2.44	1*	2.33*
Railways	0	0	0*	0.00*
Total *	**41**	**100**	**43**	**100**

Table 1 shows that as much as 76.74% of the articles published were on modelling construction duration for the building sector. This indicates that the building sector has received the highest attention with respect to construction duration modelling. The possible reason for the numerous publications in this sector could be that researchers and practitioners have found the need to develop duration models for building projects since it has been found to be a problem of concern. Another possible reason could be that the building industry award more projects than the other sectors of the industry. Most of the researchers who modelled

construction time for building projects used only cost (38.24%) as a major variable or parameter as independent variable (see table 2). This clearly indicates that majority of the researchers considered cost as a major predictor of construction time. The second highest variables used by the researchers were “gross floor area (GFA) and others”, “cost and others” and “others” with each recording 17.65%. Some of the other variables referred here include number of floors, height of buildings and number of stories among others. Readers are referred to Appendix 1 for full details of the other variables some of which are qualitative and quantitative in nature. Only 1 article representing 2.94% used only the variable gross floor area as the independent variable in model development and this was by Chen and Huang (2006). In spite of the agreement among researchers about the appropriateness of using construction cost as a determinant of construction time, Love et al (2005), Chen and Huang (2006) postulated that gross floor area is a better determinant and went ahead to develop models using this parameter. One striking observation from the review of existing literature is the absence of the use of work items in bills of quantities (BOQ) as independent variables in the development of the predictive models for building projects. The use of traditional methods of determining contract duration namely Gantt chart, critical path method (CPM) etc. used the quantum of work in determining duration of a new project. Even though cost is a function of quantity of work items, the duration of a project depends more on the quantity of work items rather than its costs (Horner and Zackieh 1993). As can be seen from table 2, none of the researchers used the quantities of work items in a BOQ in modelling construction time. Even though some of the variables such as floor area used by the researchers may be linked to some of the work items in a BOQ, the usage of the items in a BOQ would have to be explored.

The road sector on the other hand recorded seven number articles representing 16.28% and indicates the second highest attention with respect to publication. Out of these seven articles, only one was conducted for both rural and urban roads in each case and this was done by Mensah (2010). This clearly shows that these two sub-divisions of roads have been neglected or overlooked by researchers and practitioners in that sector of the industry and these represent potential gaps in the body of knowledge. In addition, the studies conducted in the road sector relied on cost (75%) as the major predicting variable (table 2 refers). This shows that in both the building and the road sector cost has been used extensively in modelling construction duration. One article representing 12.5% used “cost and others” and “others” in each case. The other variables or parameters used were length and number of civil

engineering structures and number of winters over contract period (see Czarnigowska and Sobotka 2014). Again none of them used the quantity of work items in a BOQ as determinants of road construction duration. A study conducted using these variables or parameters as independent variables is worth considering since no such study has been carried out. The reasons for suggesting the use of quantity of work items as independent variables for model development are as follows:

- Modelling construction duration using cost as the determinant by researchers has a limitation. The limitation of these models is the time value of money (changing cost for the same quantum of work over a time frame). The cost of a project in year 2000 for instance is different from year 2015 because of inflation, increase or decrease in labour costs, materials, equipment and other associated factors. This means that the developed models by these researchers will either underestimate or overestimate the duration of a project at the time of their usage. As opined by Mensah 2010, models developed using cost as the independent variable have to be regularly updated or redeveloped by construction professionals before they can be applied in determining the duration for current and future projects and this can be very expensive and time consuming. The quantities of work items, however, do not have this limitation since they do not change with time. For instance a volume of 10,000 m^3 of fill material is the same volume no matter the year it is produced and will not change with time unlike its cost. Therefore developing a model with quantities of work items (as independent variables) will offer construction professionals a better option of using a one-off developed model throughout their practice without the need for regular update or redevelopment of the models.
- The duration equals the quantity divided by the output. This means that a link between duration and quantity can easily be established.

Table 1 also shows that only 1 article representing 2.33% was published in the area of dam construction. Just like the bridge and other sub- divisions of the road sector, modelling the duration for dam construction projects has been abandoned by both researchers and practitioners. It is surprising that since 1969, when Bromilow first modelled duration for building projects, the dam construction sector has not received the needed attention as compared with the building sector. This observation from a comprehensive review is even worse when it comes to the railway sector where no such publication has been made (see table 2).

Table 2: Distribution of articles based on parameters/variables used in model

BUILDINGS			**ROADS**			**BRIDGES**		
PARAMETERS	**NO**	**%**	**PARAMETERS**	**NO**	**%**	**PARAMETERS**	**NO**	**%**
COST ONLY	13	38.24	COST	6	75	COST	1	50
GFA ONLY	1	2.94	COST & OTHERS	1	12.5	OTHERS	0	0
GFA & COST	2	5.88	OTHERS	1	12.5	ITEMS IN BOQ	1	50
GFA & OTHERS	6	17.65	ITEMS IN BOQ	0	0			
COST & OTHERS	6	17.65						
OTHERS	6	17.65						
ITEMS IN BOQ	0	0						
TOTAL	**34**	**100**		**8**	**100**		**2**	**100**

GFA is Gross floor area

With respect to bridges, only the study conducted by Horner and Zackieh (1993) was related to new bridge construction whereas that by Jiang et al (2010) was related to duration modelling for bridge replacement. In the study conducted by Horner and Zackieh (1993), the researchers used the concept of quantity significant items and critical path method (CPM) to develop a duration estimation model whiles Jiang et al (2010) used cost as the major determinant with the regression technique. These two studies constitute only 4.65% (table 1) indicating that the bridge sector has not received the needed attention as compared to the building sector. Further studies in this sector would be needed from researchers and practitioners in this field.

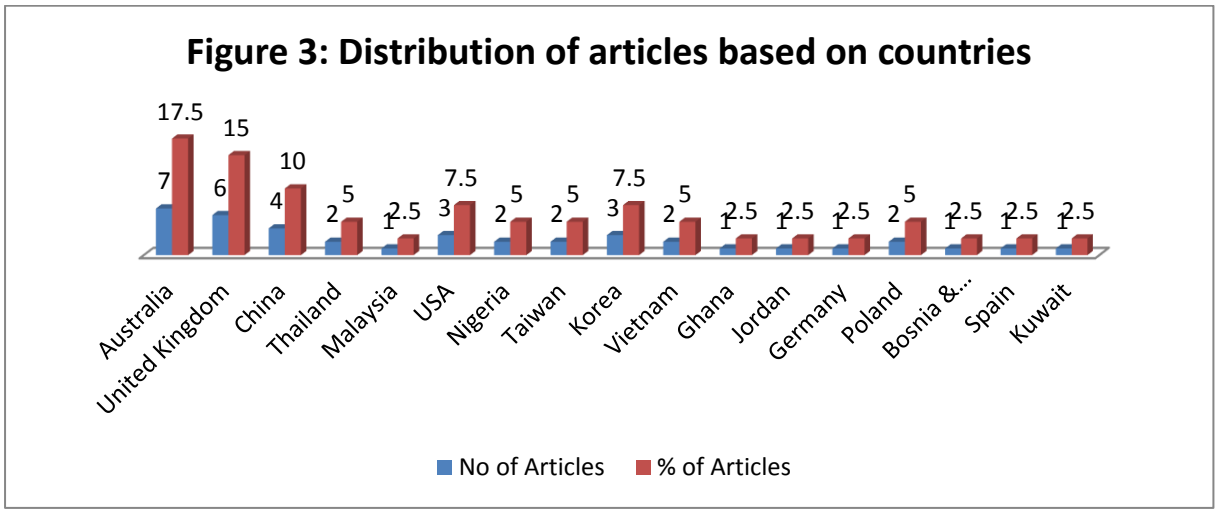
Table 2: Distribution of articles based on parameters/variables used in model (cont'd)

DAM			**RAILWAYS**		
PARAMETERS	**NO**	**%**	**PARAMETERS**	**NO**	**%**
COST	0	0	COST	0	0
OTHERS	0	0	OTHERS	0	0
ITEMS IN BOQ	1	100	ITEMS IN BOQ	0	0
	1	**100**			

Distribution of articles based on contribution of countries

Research on modelling construction duration has been done in seventeen (17) countries across the world. Out of the 40 articles (note that Dursan and Stoy, 2011 was not included in figure 3), 7 of them representing 17.5% was done in Australia and so researchers and

practitioners from this country are the highest contributors to this subject. Indeed the first article of construction duration modelling emerged from this country in 1969.



Note: The article by Dursan and Stoy (2011) was for 25 different countries and so was not included in this figure.

The second highest contributing country is the United Kingdom (15%) with the third highest country being China (10%). The USA and Korea each recorded a value of 7.5% and are the fourth highest countries. An important revelation of the first four highest contributing countries to construction duration modelling is that all of them are developed countries (Australia, UK, USA and Korea). The possible reason for this could be that these countries have recognized the need to develop a working model for its construction industry. In addition, the availability of historic data for development of the models is pronounced in these countries. Ghana, Jordan, Bosnia & Herzegovina, Spain and Kuwait each recorded 2.5% representing the least countries that had contributed to the study area.

Distribution of articles based on Statistical techniques

A number of statistical techniques are available for developing models. The pie chart in figure 4 represents the distribution of articles based on statistical techniques and other methods. Out of the 41 articles identified, the regression technique recorded the highest (78%) application by researchers (see figure 4). This indicates that this technique is the most preferred among the research community when it comes to modelling construction duration. Proponents of the use of regression techniques have argued that this technique helps to identify the variables that contribute significantly to duration estimation (e.g. stepwise regression method) as compared to the artificial neural network (ANN) which is “black box”

and limited in identifying possible causal relationship of variables. This could be the possible reason for the high application of this technique.

The application of combination of regression and artificial neural network (ANN) techniques recorded 7% representing the second highest. The articles that made use of these two techniques were Le –Hoai et al (2013), Petruseva et al (2013) and Cheng and Huang (2006). The application of only ANN and neurofuzzy techniques was 5% each. This is very surprising since the ANN has been found to have a better predictive ability as compared to regression techniques (Petruseva et al 2013, Singh and Chauhan 2009). There has been a wide application of the ANN technique in construction management and engineering in spite of the limitation of "black box". This is because the ANN is able to solve complex or non – linear problems (Petroutsatou et al, 2012) and have gained popularity in construction industry. In addition, the ANN does not make prior assumptions about the distribution of the data or the form of interactions between factors (Singh and Chauhan 2009). ANN is robust, has the ability to adapt to unknown datasets and has a good learning capability (Jha and Chockalingam, 2011). However, its application in construction duration modelling is minimal and researchers in the study area ought to consider its application in this field.

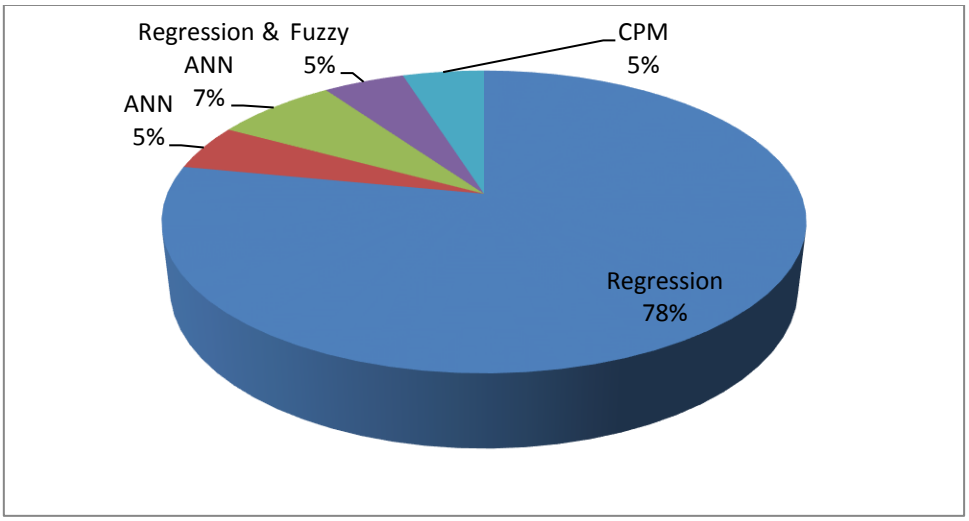


Figure 4: *Distribution of articles based on statistical techniques*

The CPM in itself is not a statistical technique. Kim et al (2016), Horner and Zackieh (1993) applied it in modelling construction duration and this represents 5% of the articles identified (see figure 4).

SUMMARY OF FINDINGS

This section summarizes the findings from the comprehensive review of literature and is as follows:

- The literature review indicated that no comprehensive review of literature on construction duration modelling has been done.
- Among the 21 journals, the Construction Management and Economics (CME) journal had by far, the largest number of articles (21.95%) on construction duration modelling. This was not surprising since it was ranked first by Wing (1997). The Journal of Engineering, Construction and Architectural Management (ECAM) had the second largest number of articles (12.2%) published in the study area. Again this journal was determined to have had the third highest score in the study conducted by Wing (1997).
- The first publication on modelling construction duration was by Bromilow in 1969 in Australia. From 1969 to 2016, year 2001 recorded the highest number (9.76%) of publications.
- Australia, the first country that contributed to modelling construction duration, had the highest number of articles (17.5%). This was then followed by United Kingdom (15%).
- 76.74% of the articles published were on modelling construction duration for the building sector. This indicates that the building sector had received the highest attention with respect to construction duration modelling. Most of the researchers who modelled construction time for building projects used only cost (38.24%) as a major variable or parameter as independent variable. This clearly indicates that cost is considered the highest predictor of construction time.
- The road sector on the other hand recorded seven number articles representing 16.28% and indicates the second highest attention with respect to publication. Out of these seven articles, only one was conducted for both rural and urban roads in each case and this was done by Mensah (2010).
- Two studies representing 4.65% of the articles modelled construction duration for bridges and these where done by Jiang et al (2010), Horner and Zackieh (1993) .These two studies indicate that the bridge sector has not received the needed attention as compared to the building sector.

- The study also shows that no research had been done on modelling duration for railways. Only one study representing 2.33% had been carried out for dam construction and this was by Kim et al (2016).
- None of the studies in the building, road and dam sectors had used the items in a BOQ as independent variables for modelling construction duration.
- The application of the use of artificial neural network (ANN) and neurofuzzy techniques in duration modelling is minimal (5% each) as compared to the regression technique (78%).

LIMITATIONS OF STUDY

Even though care was taken to identify and include all relevant journals in the study area, there is the likelihood that some of the articles may have not been identified and included in the analysis. In addition, conference proceedings and thesis were not part of the study.

The study is also limited to the following databases in English; Emerald full text, Science Direct, Ingenta Connect, Taylor and Francis, American Society of Civil Engineers (ASCE), Springer and Association of Engineering, Project, and Production Management. This list may not be exhaustive but it includes highly ranked construction journals and so can be said to be comprehensive.

CONCLUSION, IMPLICATION AND RECOMMENDATIONS

Conclusion

Underestimation or overestimation of duration of construction projects has serious repercussions on the success of a project. In view of this, research in duration modelling has received a considerable attention all over the world. However, a comprehensive literature review of modelling construction duration to identify potential gaps and recommend neglected areas for further research is missing. This study has therefore contributed to the body of knowledge by providing a solid platform for researchers and practitioners in the construction industry to appreciate the areas that have not received attention to construction duration modelling. The study has shown that the building sector has received much more attention to duration modelling than roads, dams and railways. In fact dams and railway sectors have not received attention at all and the reason for this could possibly be the non – availability of historical data for both dam and rail sectors.

Implications of findings

The study has identified potential gaps such as the use of work items in BOQs for modelling duration in the building, roads and bridge construction sectors. The findings also showed that the railway sector has not received attention by researchers and practitioners. These findings would help researchers and practioners in the construction industry who are interested in filling this gap to do so.

Recommendations

It is recommended that practitioners conduct research in duration modelling in the dam and rail construction sectors. In addition the items in a BOQ could be used in developing robust models for all the classified sectors of the construction industry. It is also apparent that researchers have used the regression, ANN and neurofuzzy in modelling construction duration. However the use of ANN and neurofuzzy is minimal. Researchers such as Petruseva et al (2013), Singh and Chauhan (2009) have indicated that the ANN produces better results or has a better accuracy than regression techniques. According to Jha and Chockalingam, (2011), the ANN is robust, has the ability to adapt to unknown datasets and has a good learning capability. However, this study has shown that the ANN technique has not been effectively applied in construction duration modelling.

In view of this, recommendations are therefore being made for the use of this technique in the study area. When this technique is used, robust models are obtained and these models could be automated for use by practitioners in the construction industry. It is also suggested that items in a BOQ be used as predictors in duration modelling for construction projects as construction projects still experience time overruns. Finally it is recommended that further comprehensive review be made to identify other potential gaps such as construction tunnelling that had not been considered in this study.

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Appendix 1: Articles Identified

NO	Researcher(s)	Year	Country	Sector	Journal	Statistical technique	Main parameters included in the model.				
1	Bromilow	1969	Australia	Building	Building Forum	Regression	Cost				
2	Bromilow	1974	Australia	Building	Chartered Builder	Regression	Cost				
3	Bromilow et al	1980	Australia	Building	Building Economist	Regression	Cost				
4	Ireland	1985	Australia	Building	Construction Management & Economics	Regression	Cost				
5	Kaka and Price	1991	UK	Building & Roads	Construction Management & Economics	Regression	Cost				
6	Nkado	1992	UK	Building	Construction Management & Economics	Regression	Gross Floor Area	area of ground floor	excavated volume	building height	number of stories
							End use	Cladding type	presence of atrium	location & intensity of services	Site accessibility
7	Horner and Zackieh	1993	UK	Bridges	Highways and Transportation	CPM	Quantities significant items				
8	Kumaraswamy and Chan	1995	Hong Kong, China	Building & Roads	Construction Management & Economics	Regressiomn	Cost	Gross floor area			
9	Khosrowshahi and Kaka	1996	UK	Building	Building and Environment	Regression	Cost	Type of horizontal Access (Good, fair, poor	Type of buildability and scope		
10	Bhokha and Ogunlana	1999	Greater Bangkok	Building	ECAM	ANN	Building function	Structural system	Height	Foundation	
							Exterior finishing	Quality of interior decorating	Accessibility to site		
11	Chan and Kumaraswamy	1999	Hong Kong, China	Building	Building and Environment	Regression	Area of external cladding/total gross floor area	Total gross floor area/no of stories	height of building/no of stories	Total gross floor area/area of ground floor plan	Duration of piling/area of ground floor plan
							Duration of superstructure/area of ground floor plan	Duration of services/duration of finishes	Duration of finishes/ duration of services	Duration of superstructure/ duration of services	Duration of services/ duration of superstructure
12	Chan	1999	Hong Kong, China	Building	Construction Management & Economics	Regression	Cost				
13	Chan	2001	Malaysia	Building	International Journal of Project Management	Regression	Cost				
14	Ng et al	2001	Australia	Building	Construction Management & Economics	Regression	Cost				
15	Boussabaine	2001 (a)	UK	Building	ECAM	Neurofuzzy					
16	Boussabaine	2001 (b)	UK	Building	ECAM	Neurofuzzy	Selection of Tendering Method	No of Tenders	Type of Contract	Fluctuation in prices	Available space in project site
							Access to project site	Slope of the project site	Ground conditions	Type of foundations & Frame	No of stories
17	Skitmore and Ng	2003	Australia	Building	Building and Environment	Regression	Contract time	Lump sum (as dummy)	Other selection as dummy		
18	Chan and Chan	2004	Hong Kong	Building	Building and Environment	Regression	Cost	type of housing scheme	precast façade	Total vol of building	Gross flor area/number of stories
19	Love et al	2005	Australia	Building	Journal of Const. Eng & Mgt	Regression	Gross Floor Area	Number of floors			
20	Shr and Chen	2006	Florida, USA	Roads (Highways)	Journal of Marine Science and Technology	Regression	Cost				
21	Ogunsemi and Jagboro	2006	Nigeria	Building	Construction Management & Economics	Regression	Cost				
22	Chen and Huang	2006	Taiwan	Building	Construction Management & Economics	Regression & ANN	Gross Floor Area				
23	Hoffman et al	2007	USA	Building	Journal of Mgt in Eng.	Regression	Cost	Air combact command	Air education & training command	Air force special operation commancd	Northwest COE region and in -house design/construction agent

Appendix 1: Articles Identified (Continued)

NO	Researcher(s)	Year	Country	Sector	Journal	Statistical technique	Main parameters included in the model.				
24	Le-Hoai and Lee	2009	South Korea	Building	Facilities	Regression	Cost				
25	Le-Hoai et al	2009	Vietnam	Building	Korea Journal of const Mgt	Regression	Cost				
26	Lin et al	2011	Taiwan	Building	Journal of Civil Eng & Mgt	Regression	Cost	Gross floor area/expected contract duration	no of stories	Modified contract duration (expected rainy days + expected contract duration)/ expected contract duration	Change order
27	Le-Hoai et al	2013	Vietnam	Building	KSCE Journal of Civil Eng	Regression & ANN	under ground site conditions	Project Mgt Works	Estimating works & accuracy and completenes s of design	competency of subcontractors	Owners Project Financing
28	Pewdum et al	2009	Thailand	Highways	ECAM	ANN	Work start date	Evaluating date	Contract duration	Percentage of as planned completion	Percentage of actual completion
29	Mensah	2010	Ghana	Roads - Highways, Urban & Rural	The Ghana Surveyor	Regression	Cost				
30	Jiang et al	2010	USA	Roads - Highways & Bridge replacement	International Journal of Const. Education and Research	Regression	Cost				
31	Hammad et al	2010	Jordan	Buildings	Journal of Mgt in Eng.	Regression	Project scope	Project area	Project Building Cost (PBC)	Project duration (PD)	
32	Dursan and Stoy	2011	25 countries	Buildings	Const. Mgt & Econ	Regression	Cost	Gross Floor Area			
33	Dursan and Stoy	2012	Germany	Building	ECAM	Regression	Cost	Gross External Floor Area	Type of facility and Project Location	Availability of construction area and Market locations	
34	Czarnigowska and Sobotka	2013	Poland	Roads	Archives of Civil & Mechanical Eng	Regression	Cost				
35	Petruseva et al	2013	Bosnia & Herzegovinia	Building	International Journal of Eng. Research & Technology	Regression & ANN	Cost				
36	Czarnigowska and Sobotka	2014	Poland	Roads	Journal of Eng,Project & Production Mgt	Regression	Cost	No of winters over contract period	Length of civil engineering structures	No of civil engineering structures	
37	Guerrero et al	2014	Spain	Building	International Journal of Project Management	Regression	Gross Floor Area	Cost/GFA	No of floors		
38	Hassan et al	2015	Nigeria	Building	Journal of Financial Management, Property and Construction	Regression	Cost	Delay in payment	Poor site & supervision by contractors	GFA	
39	Jarkas	2015	Kuwait	Building	Journal of Mgt in Eng.	Regression	Cost	No of floors below ground	No of floors above ground		
40	Kim et al	2016	Korea	Dam	KSCE Journal of Civil Eng	CPM	Quantities of work items on critical Path				
41	Jin et al	2016	Korea	Building	Journal of Const. Eng & Mgt	Regression	Gross Floor Area	Parking Area	Number of households	No of floors	
							No of roof top floors	Foundation system	Bedrock	Soil condition (average, good)	Roof type

DECENTRALIZATION, INFRASTRUCTURE DELIVERY AND POVERTY REDUCTION IN GHANA: A HO MUNICIPALITY CASE STUDY

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ABSTRACT

Decentralization has become a global phenomenon and most developing countries practice it as a strategy for reducing poverty and for effective delivery of basic services to the poor. Using the qualitative research method, this paper examines the effects of decentralization and infrastructural delivery on poverty reduction in the Ho Municipality in the Volta Region of Ghana. The paper assesses the nature and practice of decentralization as a policy intended to alleviate poverty, infrastructural delivery strategies, and the sources of funds for development/poverty alleviation projects. In addition, the paper interrogates the challenges confronting the Municipal Assembly in its quest to reduce poverty. The paper concludes that the Ho Municipal Assembly has immensely contributed to the reduction of poverty through the promotion of infrastructure delivery and other poverty reduction initiatives.

Keywords: decentralization, infrastructure delivery, Ho municipality, poverty reduction

INTRODUCTION

Decentralization of power to local communities has become widespread in the developing world. These initiatives have transferred responsibility from central government to local governments. Such initiatives surfaced in the 1980s in Armenia, Bosnia-Herzegovina, Brazil, China, El Salvador, Georgia, India, Mexico, South Africa, Uganda and Uzbekistan (Jimenez and Sawade, 1999). According to the World Bank (2000), decentralization of public service provision to local government is a worldwide trend in developing countries. Bardhan and Mookherjee (2006) identified problems of accountability associated with traditional modes of delivery involving centralized bureaucracies to include cost paddling, service diversion, limited responsiveness to local needs, limited access and high prices charged especially to the poor. For this reason, they argued that many developing countries have thus begun to experiment with initiatives to increase accountability of service providers by providing greater control rights to citizen groups. These include decentralization of service delivery to local governments, community participation, direct transfers to households and contracting out delivery to private providers and NGOs. They noted that the programmes include a wide range of infrastructure services (water, sanitation, electricity, telecommunication, roads) and

social services (education, health and welfare programmes). They therefore pointed out that countries where such trends have gathered momentum in different continents: Latin America (e.g. Bolivia, Brazil, Columbia, Costa Rica), Africa (Ghana, Uganda, South Africa) and Asia (Bangladesh, Indonesia, India, Pakistan). Indeed, since 1988, Ghana began to experiment with decentralization to reach out to the poor. It is within this framework that this research interrogated the efforts of the Ho Municipal Assembly in terms of the impacts that infrastructure delivery has on poverty reduction. Indeed, the connection between infrastructure and poverty reduction has to do with the fact that the delivery of certain infrastructure creates some opportunities for people to make income to support themselves. For example, it creates employment opportunities for people, it opens up communities to trade and business and it makes individuals to generate income through rendering their services in the construction of these infrastructure. This consequently helps individuals to fight and reduce poverty. Thus, the paper explores the various initiatives undertaken by the Assembly and how individuals have tapped into it to reduce poverty.

EMPIRICAL EVIDENCE

In Ghana, since 1983, institutional reforms towards decentralization at the district-level were promoted. Although the committees and councils have been part of the decentralization process since 1988, they were established only in 1999 through the elections to the Unit Committees of which about 16,000 exist in Ghana; in addition to 1,276 Urban, Town/Area and Zonal Councils (Thomi et al, 1999; Twum-Baah, 2000). A survey of the traditional authorities show that most traditional chiefs considered the District Assembly concept positively (Yankson, 1999). The overall decentralization process in Ghana has been classified as successful, despite its deficiencies such as corruption, delay in project implementation, financial challenges among others. However, it is a process which is ongoing and needs to be kept on track and sustainable (Thomi, 1999b). It has established the framework for successfully implementing projects that depend on participation with a strong pro-poor focus, for example, in the field of water access (Mastovak, 1999). While the overall incidence of poverty in Ghana has decreased, little benefits of the overall growth process have been felt by the poor (Twum-Baah, 2000). Indeed, generally, decentralization in Ghana has been relatively successful. However, there is the need to explore the phenomenon to the grass-root to find out what the people are saying concerning the framework and how it is affecting them. Hence the need for this study. The next session looks briefly at the conceptual framework for the paper.

Conceptual Framework

According to von Braun and Grote (2000), "in the economics literature on poverty, decentralization has long been ignored. Even research on public spending and targeting of the poor hardly touches decentralization" (van der Walle & Nead, 1995) In the mid-nineties, there was a strong focus on public sector reforms as well as capacity building and institutional strengthening to increase both, the focus on social priorities and the capacity of the state to reduce poverty (Lipton and van der Gaag, 1993). Recently, increased attention is being paid to promoting opportunities, to human resource, enhancing security and rights, and facilitating empowerment. All these are closely related to local public goods and services (infrastructure), and are directly linked to decentralization. Thus, lately decentralization and poverty reduction have come jointly into focus through the search for "good governance" and related poverty implications (Dethier, 2000).

Bahl and Bird (2013) argue that though the term "infrastructure" is commonly used in the development economics literature, it is not always defined, and can take on different meanings. They noted that the term "public infrastructure" is sometimes used to denote government investment. Alegre et al (2008) distinguishes four categories of infrastructure in terms of the functions served by it: (1) redistribution (housing, recreation, social protection), (2) public goods (defence, environment, order and safety, general public service) (3) hospitals and schools (health and education), and what they call (4) infrastructure, that is traditional public works projects, of which transportation is by far the most important in quantitative terms in most countries. Within the decentralization process of Ghana, infrastructure delivery has been linked with poverty reduction. It has been argued by Thomi (1999), Twum-Baah (2000) that decentralization and infrastructure delivery have been successful and the overall growth process has been felt by the poor. It has also been surveyed that traditional rulers have endorsed the process as the projects implemented by the Assemblies are pro-poor in focus and the overall incidence in poverty in Ghana has decreased (Twum-Baah, 2000). The argument is that, in the Ho Municipal Assembly, public infrastructure projects delivered have been beneficial to the local people as they create opportunities for people to explore their economic potentials in order to be able to fight and reduce poverty. Hence it is argued that infrastructure delivery is closely linked to poverty reduction in the Ho Municipality.

Interestingly, Besley (1997) categorizes approaches to poverty reduction into two alternatives: technocratic or institutional. The former emphasizes targeting and explores

programme designs that try to direct limited resources to people with greatest need. The latter approach notes the poor lack political power, and that administrative incompetence and corruption hinder service delivery to government. Poverty reduction therefore requires developing institutions, and changed political structures, improved governance, and changed attitudes towards the poor. Decentralization has implications for both of these two broad approaches. Decentralization may facilitate more effective technocratic programme designs, as regional targeting may be facilitated, accountability of bureaucrats may be strengthened, and managing poverty reduction programmes may be enhanced. In addition, decentralization can offer the legal framework and serve as a means for institutional approaches to poverty reduction, as it may enhance political power of the poor via increase participation. Taking these two categories of poverty reduction approaches as a base, we move towards a conceptual framework. We essentially distinguish between two sets of linkages; in both of which adverse forces and risks may interfere, undermining potential benefits of decentralization for the poor; political empowerment linkages and efficiency linkages. The diagram below gives a graphical explanation to the conceptual framework.

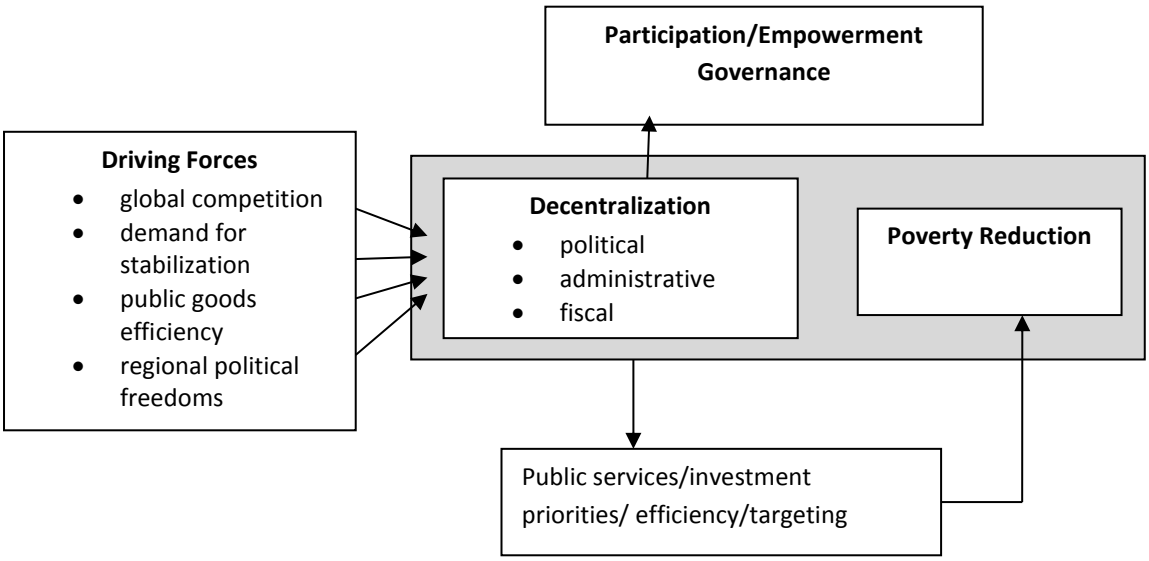

Figure 1 - *Conceptual Framework Linkages between Decentralization, Public Services and Empowerment for Poverty Reduction*

Decentralization is a way to enable civil society to participate in the policy process and thus, to increase transparency and predictability of decision-making. Local governments are generally better informed about, and more responsive to the needs and preferences of local populations than central governments. It is easier for them to identify and reach the poor as long as local politics permit this. Decentralization also has the principle advantage that local

officials can be more easily monitored and controlled by the local communities than officials in the central government, if the rule of law exists on the local level. There is also evidence that in many underdeveloped rural economies, the benefits of decentralized social programmes are captured by local elite (Bardhan, 1999; Galasso and Ravallion, 2000).

In addition, decentralization can be powerful in achieving developmental goals by assigning control rights to people who have the information and incentives to make decisions best suited to those needs (Bardhan & Mookherjee, 1998). Decentralization can also be seen as a way to increase accountability of local officials by bringing authority to the local level. Decision making at the local level gives more responsibility, ownership and thus incentives to local agents (Braun and Grote, 2000). There is some evidence that, by making local officials more accountable and placing responsibility for decision-making and implementation in the hands of local stakeholders, the quality and efficiency of public services improves (Bardhan, 1997a and b).

METHODOLOGY

This research was guided by the following research question: What is the impact of infrastructure delivery on poverty reduction in the Ho Municipality? Out of the question, the research was guided by three objectives: (a) To identify the various infrastructure projects embarked on by the Ho Municipal Assembly from the period 2009 to 2015; (b) To ascertain the sources of finance for these projects; (c) To find out the effects of these projects on poverty reduction in the municipality. Based on these objectives, the research adopted the qualitative approach.

According to Owu-Ewie (2008:111), "qualitative research is the use of interviews, documents, observations in a systematic and rigorous way to study an element in its natural setting to arrive at a meaningful conclusion through the interpretation of data collected in a subjective manner." He further explains that qualitative research is multi-method in focus, involving an interpretive, naturalistic approach to its subject matter. This means qualitative researchers study things in their natural setting which involves the studied use and collection of a variety of empirical materials, case study, personal experience, introspective life story, interview, observational, historical, interactional, and visual texts that describe routine and problematic moments and meaning in individuals' live).

The reason for adopting this methodology is to collect data from a natural setting. This is because it offers the real reactions of subjects during the study thereby providing ample information to support what has been heard and seen. Also, qualitative research offers an in-depth understanding of the phenomenon as the researcher has the opportunity to make discoveries of the procedure and meaning of situations. In addition, the qualitative approach is a flexible process which gives the researcher the prospect of modifying the research design whenever situations demand in the course of data collection (Owu-Ewie, 2008).

Accordingly, the researchers used in-depth interviews, participant observations, review and analysis of empirical materials found in the municipal assembly. The researchers interviewed top management officials such as the Municipal Chief Executive, the Works Engineer, the Budget Analyst, the Finance Officer, Assembly Members and some inhabitants of the various towns and villages in the municipality. Regarding the projects embarked on by the assembly, the researchers reviewed documents from the Works Department from the period 2009 to 2015.

FINDINGS

Infrastructure Delivery in the Ho Municipality from the Period 2009 to 2015 and the Sources of Funding for such Projects. The decentralization process in Ghana started in 1983 and it has been practised all these years. In Ghana, institutional reforms were implemented at the district level to ensure citizen participation in local governance and development. The decentralization process created a framework for the districts to successfully implement projects that depend on citizen participation and targeted at reaching out to the poor. In this regard, the Ho Municipal Assembly has not been left out of this mandate to deliver to the people. This session therefore focuses on the contributions of the Assembly in terms of infrastructure delivery and the sources of finance for these projects.

According to the Municipal Chief Executive, “In pursuant of our commitment to successfully implement the Assembly’s Medium Term Development Plan (2014-2017), works on various projects and programmes that have been initiated in the last quarter of the previous year and the beginning of this year are either satisfactorily completed or are steadily being executed for the benefit of our people.” In the light of this statement, we interrogated the various infrastructure development initiatives embarked upon by the Assembly since 2009 to 2015.

Per the records, we identified that many development projects (infrastructure) have been initiated for the benefit of the people.

These projects ranged from educational infrastructure, health infrastructure, economic infrastructure, security, road infrastructure among others. Under the District Assembly Common Fund (DACF), Urban Development Grant (UDG), District Development Facility (DDF), Ghana Education Trust Fund (GET Fund), Ghana Urban Management Pilot Programme (GUMPP), People with Disability Fund (PDF), Member of Parliament Constituency Development Fund (MPCDF), Urban Poverty Reduction Programme (UPRP)and the Internally Generated Fund (IGF), the Ho Municipal Assembly has initiated infrastructure projects such as school infrastructure (classrooms), clinics, markets, lorry parks, installation of street lights, extension of electricity, an abattoir, land fill sight, ware house, food venders shed, public toilet facilities, resource centres among others. In an interview with the officials of the assembly, they pointed out that all these initiatives are aimed at promoting the welfare of the people. But then, much of these development initiatives are aimed at empowering the people to fight poverty within the diverse sectors of the economy.

According to the Municipal Chief Executive, the assembly had received its full share for 2015, the first, second, third and fourth quarter allocations of the District Assembly Common Fund (DACF) totalling GH¢ 2,373.787.01. Regarding the People with Disability Fund, the Assembly received an amount of GH¢ 59,273.01 covering the first, second, third and fourth quarter releases. Again, the assembly received a total amount of GH¢ 181,461.30 in respect of the MP's Constituency Development Fund. In addition, a total amount of GH¢ 956,932.28 was receipted in favour of Urban Development Grant and a total amount of GH¢ 143,800.00 receipted in favour of UGD Capacity Fund. Furthermore, a total amount of GH¢ 467,006.00 was receipted in respect of the first tranche of the 2012 District Development Facility allocation while an amount of GH¢ 10,894.29 was received in favour of the implementation of HIV/AIDS response programmes in the municipality. Finally, a total amount of GH¢ 1,582,092.98 was realized as an Internally Generated Fund for the year 2015.

According to the MCE, all these various releases had significantly propelled the Assembly's quest to effectively and efficiently implement its programmes, projects, and activities to enhance the development of the Municipality. In addition, she notes that, "The Assembly is

determined to address the numerous and limitless development needs of our people and help in improving the quality and standard of life of our citizenry." The table below therefore gives a graphical representation of the some projects that the assembly embarked on from the year 2009 to 2015, their locations and the sources of funding.

Table 1: Some projects embarked on by the Ho Municipal Assembly from 2009 to 2012

Project Name	Location	Source of Funding
Construction of a 10 seater communal KVIP	Taviefe	DACF
Construction of a septic tank and 10 shower latrine	Ho-Hliha	DACF
Construction of a 10 seater communal vault latrine	Tokokoe Abudi	DACF
Construction of CHPS compound	Kpenoe	DACF
Construction of CHPS compound	Kpenoe	DACF
Construction of a 6 unit classroom block	Sokode	DACF
Construction of a 6 unit classroom block	Ando Takla Tokor	DACF

Source: Ho Municipal Assembly Projects (2009-2015), Works Department - HMA

The table above shows clearly some of the infrastructural development initiatives embarked upon the by Ho Municipal Assembly in various towns within the municipality between 2009 and 2012. From the table, one can see clearly that much of the infrastructure is focused on health and sanitation, education, water, and security. In our own estimation, these are essential needs of the people, which will enhance good health, and the total well-being of the citizenry. The next table presents data on the infrastructural development initiatives by the Assembly from 2013 to 2015.

Table 2: Some Infrastructure projects embarked on by the HMA between 2013 to 2015

Project Name	Location	Source of Funding
Construction of Early Childhood Development Centre	Matse	UDG
Construction of Nyive market	Nyive	UDG
Construction of 6 unit classroom block	Klefe	UDG
Construction of Early Childhood Development centre	Akoefe Avenui	UDG
Construction of 2 Police Posts	Loboli/Taviefe	UDG
	Deme	DDF
	Sokode Ando	DDF
Construction of kindergarten block	Takla Tokor	DDF
Construction of a kindergarten block	Ho Housing	DDF
Supply of 250 street lights	Ho Municipality	GUMPP
Construction of 2-storey 16 unit shops	Ho	GUMPP
Construction of engineered landfill site	Ho	GUMPP
Construction of an abattoir	Sokode Gborgame	GUMPP
Reconstruction of the Ho Central Market - 116 shops	Ho	GUMPP
Reconstruction of the Ho Central Market - 115 shops	Ho	GUMPP
Construction of a 2-storey warehouse	Ho	UPRP
Construction of food venders shed and 12 unit water closet	Ho Mawuli School	UPRP
Construction of resource centre	Sokode Ando	

Source: *Ho Municipal Assembly Projects (2009-2015), Works Department - HMA*

The table in above clearly shows the level of investment in infrastructural delivery by the Ho Municipal Assembly towards enhancing the welfare of the citizenry. This cuts across education, health, economy, and security. The question then is what is the impact of these infrastructures on poverty reduction in the municipality? The next session focuses briefly on this theme.

The Impact of Infrastructure Delivery on Poverty Reduction in the Ho Municipality: The Informant Perspective

In an interview session with some informants in the municipality, they noted that the Ho Municipal Assembly has initiated certain development projects which have been beneficial to

the people economically. They argued that projects such as the reconstruction of the Ho Central Market, the construction of the Nyive market, the Ho Ahoe market, the construction of an abattoir in Sokode Gborgame, the construction of Ho to Nyive/Klave roads, Ho to Taviefe/Matse roads have created some employment opportunities to the citizens. The table below gives a breakdown of the employment opportunities created by these projects.

Table 3: Employment opportunities created for the local people through infrastructure projects of the Ho Municipal Assembly

Project Name	Town/Community	Number of Employees	Work Description
Construction of abattoir	Sokode Gborgame	15	Labourers, drivers, masons, etc.
Construction of Ho Central market	Ho	40	Masons, drivers, security etc.
Construction of Nyive market	Nyive	20	Masons, painters, carpenters
Construction of Ahoe market	Ho Ahoe	12	Carpenters, masons, security
Construction of Engineer landfill site	Akrofu	35	Labourers, drivers, security etc.
Construction of CHPS Compound	Kpenoe	5	Cleaners Security
Construction of a CHPS compound	Akoefe	4	

Source: *Ho Municipal Assembly Projects (2009-2015), Works Department - HMA*

The table above shows that in all the infrastructure projects embarked on by the Assembly, it has created employment opportunities for the people within the various towns and villages. People have been employed as drivers, carpenters, security men, cleaners, masons among others. Directly or indirectly, it leads to poverty reduction since they generate income to support their families.

Again, they argued that projects such as the Community Health Planning Systems (CHPS Compounds) or clinics, the construction of public toilets, are also aimed at creating opportunity for the people to access health facilities to improve their health. They also enable individuals to stay healthy and maintain a hygienic environment. This in turn will help them to engage actively in the economic activities to generate income for their families. The

construction of the engineered landfill site in Akrofu, the construction of the abattoir at Sokode with its associated facilities will provide employment opportunities to both men and women in these villages to engage actively in economic activities. This will provide them with means to generate income to improve upon their standard of living.

In addition, informants argued that the construction of educational infrastructural facilities give opportunity to children to acquire knowledge in serene atmospheres so that they can fully develop their potentials. This will enable them to study hard to become useful citizens in their communities. Again, teachers who teach in these schools will be committed to their work and promote quality teaching and learning. The resultant effect is that, they will be building the capacity of the children to help fight poverty in their respective communities.

CONCLUSIONS

The data gathered from the field indicate that the Ho Municipal Assembly since 2009 to 2015 has contributed immensely to infrastructure delivery for sustainable development and poverty reduction in the municipality. From the data, the municipal assembly has constructed classroom blocks for schools, clinics for communities, market centres for trade and business, road infrastructure to open up the municipality for trading activities, creating employment avenues for people generate income, extension of electricity to enhance security of citizens, construction of police posts to strengthen the security system in the municipality among others. All these development initiatives have directly or indirectly contributed to poverty reduction in the municipality. Based on this, we can conclude that the Ho Municipal Assembly has contributed tremendously to poverty reduction through infrastructure delivery and other poverty reduction strategies.

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THE REPERCUSSIONS OF INFRASTRUCTURAL DELIVERY BY NON DOMESTIC CONSTRUCTION COMPANIES IN DEVELOPING NATIONS

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Abstract
The paper posits that infrastructure delivery can be a means to overcoming the challenges with the construction industry development agenda, depending on who delivers it. The objective of the paper are to identify the origin of construction companies that mostly deliver infrastructures in developing countries and the impact of such situation on the construction industry development agenda of such countries. By design the paper is descriptive. The paper uses literature review as the method to identify, summarize and synthesize literature on infrastructure delivery and its impact on construction industry development agenda of developing nations with particular focus on Ghana. The paper finds that majority of infrastructure projects are executed mostly by non domestic construction firms largely due their greater experiences and resources which give them competitive advantage over their domestic counterparts. The need exist for strategies to address the impact of the massive takeover of infrastructural delivery by non domestic construction firms on domestic construction firms in Ghana, and its effect on the construction industry's development agenda. The paper proposes the use of marketing and networking as a means to overcoming the situation. The paper opens new directions of infrastructural delivery research that focuses on the impact of the activities of non-domestic construction companies on the Ghanaian construction industry generally and the Ghanaian construction industry development agenda.

Keywords: construction industry, Ghana, infrastructure, marketing, networking**.**

INTRODUCTION

Infrastructure needs of every nation are provided by the construction industry in most cases. The construction industry is therefore considered as an economic backbone and major contributor to the Gross Domestic Product (GDP) of many nations development (Hillebrandt, 2000; Lopes, 2012; Ofori, 2012; Winch 2010, Wong *et al.* 2010) especially the developing nations such Ghana. There is a strong link between construction and economic activity (Anaman and Osei-Amponsah, 2007) and the projected economic growth in Ghana. In Ghana for instance, the construction industry's contribution to GDP has shown an increasing trend from 8.5% to 11.8% from 2010 to 2013 respectively (GSS, 2014); a sign of its growing importance in the development of the nation. Not only do these provisions of infrastructure contribute to GDP growth, they also provide a means by which the industry obtains the necessary resources in terms of financial gains needed for its development. Infrastructure

delivery can therefore be used to develop the construction industry of nations especially in developing nation, where infrastructural needs are comparatively much greater.

Ghana as a developing economy has a great need for physical infrastructures, which are built through construction activities. Such infrastructure includes schools, hospitals, airports, highways, roads, hospitals, power plants, dams, housing, maintenance on existing infrastructure, and seaports, bridges, roads, houses among others that contribute to the socio-economic development of the country (Ofori, 2012; United Nations Human Development Report/Index, 2008; Jaselskis and Talukhaba 1998: 185). The relationship between infrastructural delivery and the construction industry suggest that the greater the infrastructure needs of a nation, the greater the gains to the construction companies that deliver it. These gains which occur in terms of financial benefits are vital resources needed for the construction industry development. Although these financial gains are highly desirable, it has become hardly feasible for domestic construction companies to obtain them. This is due to the challenges that come along with situations where a nation has great need for infrastructures (Ofori, 2012).

In most countries, especially developing nations, the enormity of such needs attracts construction firms both within and outside which also makes the country ripe for competition. Also, in this era of globalization, which means collapse of boundaries, all nations has become competing nations in an attempt position themselves to attract foreign investment (Ofori, 2012). As a result the opportunity offered by ECOWAS and globalization further increases the intensity of the competition. The Ghanaian construction industry's ability to take maximum advantage of the opportunities for its own growth is the biggest question today because competition remains the big challenge of the industry.

High competition and high risk have been considered as the construction industry's major challenge (Schaufelberger 2009). Mochtar and Arditi (2001) contend that, the construction industry is typically characterized by extreme competitiveness, high uncertainty and risks, and generally low profit margins when compared to other industries. In Ghana, these constraints are exacerbated by globalization, which has manifested in an inflow of investment into Ghana from other countries. Although, it creates work opportunities however, domestic construction consultants, contractors and individual practitioners face greater competition from their non domestic (foreign) counterparts that are likely to have greater experience and

resources (Ofori, 2012). Similarly, the opportunities offered by the Economic Community of West African States, has also lead to an influx into Ghana of firms from the other member countries that further escalates the intensity of competition prevailing in the industry.

The rapid changes occurring in the construction industry also affects infrastructural delivery. The changes in project procurement and implementation processes and the pervasive utilization of information and communication technology (ICT), changing client needs in the construction industry, advances in technology, and the particular needs of the country as a developing economy (Matzdorf *et al*., 1997; Jaafar *et al.*, 2008) affects construction industry and the stakeholders such as the contractors and consultants. These are the driving forces behind the construction industry's development agenda in many countries, including Ghana.

To navigate these waves of change, construction companies constantly seek ways to outbid their competitors and explore new and/or less crowded areas of construction that may provide more jobs and higher profits. In this context, marketing may help construction companies to differentiate themselves from their competitors, cultivate and/or keep clients, and thereby create competitive advantage (Arditi *et al.* 2008; Chen and Mohamed 2008). In addition to marketing is networking, which has been described as a phenomenon that is "reshaping the global business architecture" (Parkhe et al., 2006, p. 560). Networking has been recognized as a fundamental component for small to medium sized enterprise (SME) survival and growth. Networking is known to be useful in assisting owner/managers to obtain both vital resource allocation and information sharing/knowledge transfer (Jack, 2010; Havnes & Senneseth, 2001; Gronum et al., 2012; Ge et al., 2009).

The construction industry derives its success from the individual construction companies that makes up the industry. Capacity building of domestic construction companies is therefore imperative for the success of the construction industry development agenda. Hence the need for the right cooperate strategies such as marketing and networking, to enhance the competitive advantage of domestic construction firms to effectively compete with their non domestic counterparts. Highlighting on the role of individual construction companies towards the construction industry development, Ofori (2012) argues that the:

> *local construction consultants, contractors and individual practitioners will face greater competition from their foreign counterparts which are likely to have greater experience and resources. Another challenge will be for the local construction*

industry to exploit the opportunities offered by the Economic Community of West African States, and address its possible negative impact such as an influx into Ghana of firms from the other member countries (P. 16-17).

The rest of the paper examines the repercussions of infrastructure developments in developing countries. It further examines marketing management and networking as the right cooperate strategy to address the repercussions. It finally concludes by drawing the attention of construction management researchers to new areas of infrastructure delivery research that can make a profound impact on Ghana's construction industry development agenda.

INFRASTRUCTURAL DELIVERY IN DEVELOPING NATIONS

Who Delivers It?

The enormity of infrastructure needs of many developing countries explains why many multinational firms have moved to developing countries where a lot of markets are emerging to do business (Wooldridge, 2010). Because such countries are mainly developing countries, there are lots of demands for all types of construction work (Jaselskis and Talukhaba, 1998) and that demand presents work opportunities for construction companies. Also, the existence of huge infrastructural deficit in such countries impedes the nation's economic and social growth. In an attempt to accelerate the 'bridging of infrastructure gaps' to overcome existing deficits in infrastructure, many developing countries have instituted incentive packages designed to attract foreign investment and foreign firms including tax reliefs. In Ghana for example, the Free Zones Act, 1995 was passed *inter alia* to provide incentives such as tax concessions to firms granted licences under the Act (Laryea 2010).

As a result of such facilities, the market for major projects in developing countries tends to be dominated by foreign contractors (Laryea, 2010). In a study on contractor development in Nigeria, Adams (1997) found that major projects in most developing countries are carried out by foreign contractors because of deficiencies in indigenous construction capacity. A similar finding was reported by Aniekwu (1995) in the study of business environment of contractors in Nigeria. Of the 344 respondents, 266 were indigenous contractors (wholly Nigerian-owned) and 78 foreign contractors (either Nigerian branch of a foreign company or Nigerian/foreign joint venture). Although 78% of contractors were indigenous firms, their total share of annual construction work was likely to be significantly lower than the total annual volume of work done by the 22% foreign firms. These findings are indicative of the

major takeover of construction related jobs by foreign firms in developing countries. The stack reality is summed up in the account of an interview with Ghanaian contractors reported by Laryea (2010):

> *One contractor said that a Ghanaian contractor who wants to increase and build their capacity should approach foreign firms who might like to sublet some of their work. This would help the local contractor in developing capacity and learning and transferring knowledge. One contractor explained that "Chinese firms in Ghana don't give work to local contractors in Ghana because the Chinese work 24hours and Ghanaians work just 5hours* (P. 225).

The above situation is an indication of the extent to which the domestic construction companies are denied of the opportunity to participate in the infrastructure delivery of their own counties. It also shows the extent to which local construction companies are struggling for construction and construction related works that are at the disposal of the non domestic construction companies. Domestic contractors can at best wish for sublet works (not main works) from non domestic construction companies and at worst not get the work at all. Even their desire for subcontracting works from the non domestic construction companies is merely a wishful thinking that has no guarantee.

What is the result?

It is obvious from the foregoing that virtually none of the construction projects is left for the domestic construction companies Layea (2010). The results of this are numerous. According to the GoG (2000) report, numerous challenges are confronting construction contracting and consultancy companies in Ghana. The list includes:

- Inability to secure adequate working capital
- Inadequate management
- Insufficient engineering capacity
- Poor workmanship.

The problems of consultants include:

- inadequate operating cash flow
- inadequate flow of jobs
- low level of fees, hinders the development of their technical support system
- low productivity

- poor quality of work
- lack of means and opportunities for providing training (Ofori, 2012:16).

Several other researchers have also identified other challenges of the construction industry. In the work of Fugar *et al*. (2013), the seven key challenges identified include;

1. absence of a principal development regulatory body,
2. Inadequate financial resources,
3. Lack of investment in human resource development,
4. Inability to embrace change,
5. Low technology in the industry,
6. Lack of appreciation for workforce in the industry and
7. High level of employee mobility

All these factors can be traced back, directly or indirectly to the fact that domestic construction firms that constitute a greater part of the construction firms that makes the construction industry have not had the chance to participate fully in the infrastructural delivery of Ghana. As a result the firms are denied of the numerous benefits that can result from undertaken infrastructural projects. Principal amongst such benefits are financial gains (Eyiah and Cook, 2003), which is the single most important factor needed to overcome most of the challenges highlighted earlier. Firms with sufficient financial resources can successfully deal with issues with employee mobility since employees mostly move to other firms due better financial gains they hope to receive. In a similar vein, firms with adequate financial resources can also adopt high technologies since such technologies come along with the use of some plants and equipment which require huge capital investment for their acquisition.

The study of Eyiah and Cook (2003) was carried out with the aim to identify the financing needs and constraints of contractors in Ghana; determine the extent to which their characteristics influence financing needs and constraints; examine factors contributing to these constraints and the effect on different groups of contractors; and develop guidelines for policy-makers. In conclusion, Eyiah and Cook (2003) advocated for more but effective financing schemes for local contractors. Eyiah and Cook (2003) also cited contractor inability

to service equipment loans; disparity between Ghanaian currency and foreign currency in which cost of equipment was to be repaid among others.

What is remarkable in other works that highlights challenges confronting the construction industry is that all the authors converge at this one factor: absence of a central agency to regulate and ensure the continuous development of the construction industry. That makes this single factor appear as pivotal challenge amongst all other known challenges confronting the construction industry of Ghana. This factor has been associated with the construction industry development of Ghana as the major stumbling block (Ofori, 2012).

Although, this is an important factor, it may not be entirely the overall problem. The performance of the individual domestic construction companies also has a role to play. Many of the challenges highlighted earlier as confronting the construction industry of Ghana can be overcome if the domestic construction companies are able to secure adequate share of the infrastructure projects. This will enable domestic construction companies to obtain essential resource to improve their own performance which will in turn contribute to the construction industry development agenda.

What is essential in this regard is the business-like approach that is lacking in domestic construction companies. Comparing the way domestic construction firms do their business to the non domestic construction firms, Laryea (2010) concur that:

> *We are running our economy on an 8-hour basis whiles people in advanced countries run theirs on 24hrs so naturally we cannot compete. If we don't increase production how can we grow the economy? We have to move a step further. Collectively we have a long way to go." therefore, there is a lot of opportunity for the contractor who is serious in developing a professional approach to business* (P.225).

THE WAY FORWARD

Marketing and Construction Enterprises Management

Marketing management is now widely adopted by manufacturing, distribution and many more service industries. Although marketing has a wide application in many industries, it has not yet been applied to any great extent by contractors in the construction industry, except those engaged in speculative house building where its benefits are comparatively understood.

With serious reduction in demand for construction services in recent years, marketing is expected to arouse the interest of construction contractors.

Naranjo *et al.,* (2011) concur that

> *'Construction enterprises are aware of the importance of involving marketing in their management functions as a way to adapt themselves not only to the continuous changes in the industry, but also to satisfy their clients' demands, while being competitive and improving their business strategy*' (Naranjo *et al*., 2011:245).

This, notwithstanding, the adoption and implementation of marketing in the construction industry continue to remain an uphill struggle with little to no success. The industry is known to have a record of poor performance in most of the marketing management related areas of managing a business enterprise (Preece *et al*., 2000), as noted by Naranjo *et al*., (2011).

The argument by Kotler and Keller (2012:3) that: *financial success often depends on marketing ability"*, suggests that business functions such as finance, operations, accounting, and others are important but marketing is key to survival of the business enterprise. The authors justify this saying that the other business functions: *won't really matter without sufficient demand for products and services so the firm can make a profit.* (Kotler and Keller, 2012:3)

However, construction enterprise management practices according to Cicmil and Nickolson (1998:96),

> "*suffers from a "cast in concrete", inwards-oriented management paradigm which forms a barrier to the implementation of some contemporary managerial techniques and philosophies, now widely recognised and adopted in other industrial sectors".*

Marketing is among the managerial techniques which are now widely recognized in many industries. However, the inward-oriented management paradigm prevents it utilization in the construction businesses.

Cicmil and Nickolson (1998), further states that:

> *"Construction business practices suffer from parochial attitudes to ownership of projects, technically biased operations, and conservative, efficiency-based approach to management. Novice propositions, such as the acceptance of customer-oriented policies through partnering, synergy, professional concurrence and organisational*

systems conducive to learning, have been a topic of major academic and professional debates on culture change in the construction industry" (p. 96)

The authors further argue that:

"Management practices in the construction industry are dominated by the engineer's paradigm (Seymour and Rooke, 1995) which leaves a rather limited scope for implementation of contemporary business theories, management processes and behavioural change, such as marketing driven strategic management or total quality management (TQM)". (p. 97)

Many other researchers such as Betts and Wood-Harper, (1994); Cicmil and Egan, (1996); Seymour *et al.*, (1997) and other have made similar observations. Typical management structure of construction business enterprise is illustrated in figure 1. It is obvious that the addition of marketing to the business functions appears to be a wishful thinking. Morgan and Morgan (1991) states that marketing within the construction profession is considered at worst as an alien concept, and at best as a new development that is viewed with scepticism. Similarly, Pheng (1991) observed that marketing has attracted only little attention among construction professionals. Morgan and Morgan (1990) also stated that marketing is less developed in the professional industry and often performed in most firms in an *ad hoc* basis. This augments the assertion that marketing is not seen as a source of competitive advantage by most construction business companies.

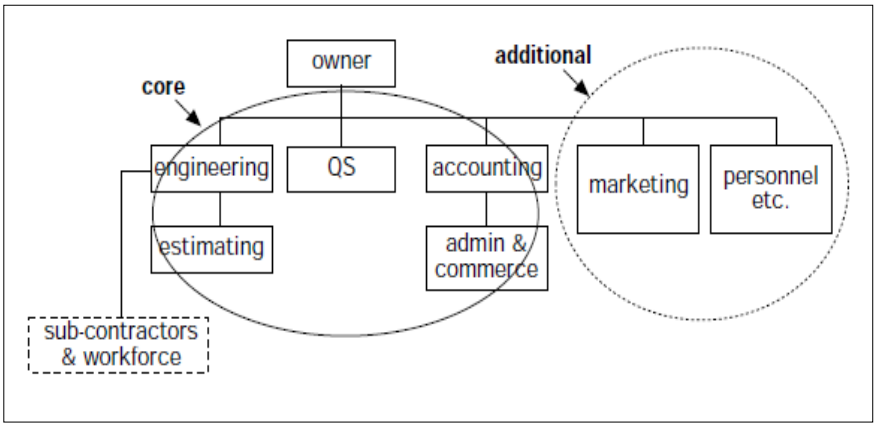

Figure 1: *An outline of a typical organisational structure development in a small/medium construction contracting company*. Source: Adopted from Cicmil and Nickolson (1998)

Yet to survive competition and to grow, construction companies need to constantly seek ways to outbid their competitors and explore new and/or less crowded areas of construction that

may provide more jobs and higher profits. To this end, marketing which has been referred to as "an investment for creating a competitive edge – an empowerment for competitive advantage" (Arditi et al, 2008, P255) is recognized as one of the more important functions for helping the construction companies to meet the unprecedented challenges faced by them (Kotler and Conner, 1977). In this context, marketing may help construction companies to differentiate themselves from their competitors, cultivate and/or keep clients, and thereby create competitive advantage needed to effectively compete with non domestic construction companies (Arditi *et al.* 2008; Chen and Mohamed 2008).

Marketing therefore become the fundamental component for the growth and survival of construction companies by enhancing their knowledge to ensure continuous relevance and to enable them move quickly into new areas of service as opportunities arise. Kotler and Conner (1977) noted that a successful competition of a firm that leads to survival on the market requires the achievement of three major objectives i.e. a sufficient demand a sustained growth and profitable volume. This according to Jaafar *et al*., (2008) justifies the important role of marketing practices in the management of construction companies.

Networking of domestic construction enterprises

Networking is described as a phenomenon that is "reshaping the global business architecture" (Parkhe et al., 2006, p. 560). Networking has been recognized as a fundamental component for small to medium sized enterprise (SME) survival and growth. Networking is known to be useful in assisting owner/managers to obtain both vital resource allocation and information sharing (Jack, 2010; Havnes & Senneseth, 2001; Gronum et al., 2012; Ge et al., 2009).

Such knowledge about networking underscores its importance which explains why it has been research extensively. Because of its proven ability, research on networking no longer focus on determining whether networking is important, but rather on which networking drivers that enable the utmost successful participation. Zhao & Aram, (1995) argues that networking ultimately consists of two dimensions: network *intensity*, i.e. the extent to which SMEs participate in networking activities and network *range*, i.e. the span of contacts within the network. These two dimensions have been shown to positively influence vital factors such as successful firm survival and firm growth (Ge et al., 2009; Watson, 2007; Zhao & Aram, 1995).

The benefits of networking are numerous. It allows firms to influence what resources and, thus, what strategic options that are available to them (Coviello & Munro, 1995). And since expanding an enterprise with only internal resources is extremely difficult (Lechner & Dowling, 2003; Ritter & Gemunden, 2004; Kirkels & Duysters, 2010) domestic construction companies which are mostly small to medium sized enterprises (SMEs) are increasingly encouraged to develop external networks (Street & Cameron, 2007; Ritter & Gemunden, 2004; Havnes & Senneseth, 2001; Kirkels & Duysters, 2010) to obtain the needed resources to be competitive.

It has been empirically proven that belonging to external networks will benefit SMEs long term, because networks enable firms to access resources that are important for their overall growth, performance and survival (Ge et al, 2009; Street & Cameron, 2007 Ritter & Gemunden, 2004; Havnes & Senneseth, 2001; Kirkels & Duysters, 2010; Hanna & Walsh, 2002). Networking, therefore, has the potential to enable such 'domestic construction enterprises' to obtain the necessary resources needed for competitive advantage.

DISCUSSIONS AND DIRECTIONS FOR FUTURE RESEARCH

Summary of Findings

The paper demonstrates that active participation in infrastructural delivery by domestic construction companies may be used to address many of the challenges facing the construction industry in Ghana. This will in turn enhance the effort towards developing the construction industry of Ghana.

The paper has further shown that the establishment of a central regulatory agency may not be the only sure way towards success of construction industry development agenda, as has been indicated by many researchers in this field of research. This is because the construction industry environment is now experiencing a new wave of challenge: competition which has arisen out of globalization and other changes occurring in the construction industry. As a result what are equally important are marketing as a management function in the operations of a construction business enterprise and networking of construction business enterprises as a means to obtain vital resources allocation and information sharing relevant to building domestic construction companies' capacity for competitive advantage.

Managerial Implications

Management of construction business enterprises must embrace marketing in their management functions. Management must also begin processes of networking with other construction businesses as means to build their capacity for competition.

Directions for Future Research

Future research must focus on the role of marketing in the operations of a construction business enterprise in face of competition. Again, the prospects of utilizing networking of domestic construction companies, as a means to achieving competitive advantage demands investigation.

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IDENTIFYING CRITERIA FOR ENVIRONMENTAL SUSTAINABILITY IN HOUSING DEVELOPMENT IN ABUJA NIGERIA

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ABSTRACT

As momentum continues to increase over the depletion of our natural environment, principles of sustainability practise has continued to raise more attention both locally, regionally and globally. This is evidence by the number of various concerned advocacy, conferences and seminars being held on the issue. Initiations have prompted philosophies and strategies in pursuing affirmative action and policies in numerous countries to engage and implement sustainability within the built environment. The aim of this research was to identify the criteria for environmental sustainability in housing development within Abuja. Using survey method, semi structured interview was conducted with stakeholders who included estate surveyors,architechts,townplanners,builders,quantitysurveyors,architechs and the community members, these stakeholders were selected using Delphi method. the results show that the criteria is numerous just as the stakeholders are numerous, however a consensus was reached on how environmental sustainability can be achieved in housing development in the federal capital territory. The implication is that government alone cannot ensure environmental sustainability in housing development.

Keywords: Criteria, Environmental Sustainability, Development Housing, Identify.

INTRODUCTION

Housing provision is a major challenge facing not only developing countries but also the developed ones, for example, in the UK there exist a housing demand of over three million houses in England (Herath and Prato,2006). This challenge is more pronounce in developing Countries and will remain a major socio-economic and financial problem for these economies, Nigeria inclusive (Iyagba 2012). This problem led 131 Nations, including Nigeria, to endorse 64 recommendations of 'National Action Plan' at the United Nations conference on Human settlement, on the 11th of June 1976 in Vancouver Canada. Meeting

this challenge globally has led to plundering the natural environment without regards to its preservation or protection, and thus extends to a more complex problem. About 170 Nations met at Rio de Janeiro, Brazil, on June 3rd 1992 for another United Nation Conference tagged "Earth Summit," or ''Rio Declaration on Environment and Development.'' The debate centred on sustainability, with particular emphasis on resolving the conflict between development and the environment, however current debate is critical about the lack of post-Rio momentum at both political and practical level (Agbola1999).

Nigeria is a signatory to the 'Rio declaration' and is laden with huge housing deficit. It struggles in achieving sustainable environment which are noticeable through the various policy formulations and advocacy (Abolore, 2012). The 1999 constitution in section 20 of the law which states that: 'The State shall protect and improve the environment and safeguard water, air and land, forest and wildlife of Nigeria'' There are other examples such as the local environmental laws which have been enacted to protect the land use and the National Policy on Environment (1989) . The quality of the environment, conserving and using the environment for the benefit of present and future generations. There are other initiatives from the government that promotes public awareness on the link between development and the environment; international co-operation with countries and international organizations in the protection of the environment.

Other recognized environmental protection provisions are: the Harmful Wastes Act Capped 165, which was the immediate reaction to the dumping of toxic waste product in Nigeria in 1988. And Environmental Impact Assessment Decree 86 of 1992, this is the core legislation that governs environmental impact assessment with regard to proposed projects in Nigeria and drifts directly from the provisions of principle 17 of Rio declaration (Arayela, 2002). Recently persistent flooding (see figure 1 below) and extreme surface temperature in the (FCT) has been reported in media and professionals blamed it on indiscriminate housing development without due considerations for the environment (Premium Times 2013, Daily Times, 2012), it is also asserted that another major effect of such practice is vegetation stress, rapid plant loss and desertification (FGN 2013). The aim of this paper was to identify the criteria for environmental sustainability in housing development within Abuja.

Figure 1 - *Showing part of the central business district in Abuja after a down pour*
Sources: http://www.dailytimes.com.ng/article/flood-awareness-campaign-kicks-abuja.pg6

ISSUES OF ENVIRONMENTAL SUSTAINABILITY AND HOUSING

As momentum continues to increase on concerns over the depletion of our natural environment, principles of sustainable practice has continued to raise more attention globally (John et al,2012). This is evidence by the number of various concerned advocacy, conferences and seminars being held on the issue. The activities within the build environment is said to contribute between 30-40% of greenhouse gases globally (Samson and Moses,2013). As identify in literature housing provision takes centre stage in depletion and pollution of the environment (Agbola,1999). Abolore (2012) opined that ‘‘the build environment provides a synthesis of environmental, economic and social issues’’ he asserted that it provides us with houses, infrastructures and also plays a vital role in our economy. Herath and Prato (2006) concludes that its design is significant in determining the pattern for the resource consumption over its relative life cycle. Initiations have prompted philosophies and strategies in pursing affirmative actions and policies in numerous countries to engage and implement sustainability within the build environment. For example, requirement for implementing sustainability issues in property valuation, architect are being asked to provide sustainable designs while planners are promoting sustainable cities, engineers and builders are advocating sustainable construction (Lorenz 2006, Majdalani et al 2006, Arayela 2002).

Abolore (2012) concludes thus ‘The transition to sustainability is urgent because global life-support systems — the environment — has a time limit. We do not have time to dream of

creating more living space or more environment; we must save the remnants of the only environment we have, and allow time for regeneration of what we have already damaged’’.

Sustainability has been defined in deferent context by different authors, one of the most acceptable definitions is that by the Brundtland Commission'(WCED, 1987), UNCED's Earth Summit (in 1992) and the position of Canada (1992)Environmental sustainability (ES) means maintaining global life-support systems, or more specifically, maintaining environmental sound capacities to assimilate wastes, and maintaining environmental source capacities to regenerate raw materials, such as healthy air, water.’’

Using this definition Abolore (2012) concludes: “Environmental Sustainability means maintaining both the sources of raw materials and energy within its regenerative and assimilative capacities’’.

IMPACT OF HOUSING DEVELOPMENT ON ENVIRONMENTAL SUSTAINABILITY

Housing is one of the key demands of man beside food and clothing. However, there have been challenges in recent time in the construction and provision of housing. Higher property prices have affected the affordability of houses and reduced economic competitive for some industries (Long et al, 1990), it has been estimated that buildings contribute around 30-40% of greenhouse gas emissions globally (Kruja and Hasaj, 2010). The world green building council (world GBC) mission is to accelerate the transformation of the built environment towards sustainability (world GBC, 2010), studies have indicated that sustainable buildings will play an important role in New-Zealand property portfolios in the future (Lozano 2008). Energy Efficient commercial building designs and the use of building materials that enhance energy efficiency offer major opportunities to lock in substantial energy savings throughout a building’s life (EECA, 2011).

In conclusion, the idea is to maintain a balanced relationship between cost, quality and time on one hand while addressing environmentally sustainable housing scheme on the other which will in turn deliver both economic and social sustainability.

RESEARCH APPROACH AND METHODOLOGY

Delphi method was adopted for the first round of interview which involved 9 experts who were selected based on the following criteria as expounded by (Fellows and Liu,2008):

1. Publications in the field
2. Signs of professional eminence such as leadership, membership or holding office in a professional society or organization
3. Peer judgment and recommendations
4. Honours' by professional societies
5. Self-rating of the expertise in the relevant area
6. Presentations made at national conferences and workshops
7. Relevant years' experience

The survey methods involve the use of semi-structured face-to-face interviews which was used to develop answers to the research question and to validate answers to the research question(Fink 2003) .

The rationale for adapting this approach hinges on a number of cogent considerations. Fink (2003), Gill and Johnson(2012) and other researchers observed that the method offers a logical template to study selected issues exhaustively, they further claimed that approaching research work without being constrained by predetermined categories of analysis contributes to the depth, openness and details of qualitative enquiry.

TECHNIQUES FOR DATA COLLECTION

Semi-Structure Interview

Semi-structured questionnaire was used for the interview of the respondents

Gill and Johnson (2012) state four distinguished characteristics of the semi-structured interview or, as they named it, a focused interview:

- It takes place with respondents known to have been involved in a particular experience. –
- It refers to situation that have been analysed prior to the interview.
- It proceeds on the basis of an interview guide specifying topic related to research hypothesis.
- It is focused on the respondent experiences regarding the situations under study''.

Data Analysis and synthesis - The data was analysed using descriptive statistics

TABLE 1 - *Showing background of respondents from the Delphi exercise*

Specialization	Respondent	Educational Qualification	Years of Practice	In Academic	In Private Practice	Duration of Interview(minutes)
Q.S	A	B.Sc. ,MSc (PhD in view)	26	16	10	31
Environmental mg	B	B.Sc, Msc	16	10	6	34
Land Surveyor	C	B.Sc.	15	5	10	29
Estate Management	D	B.Sc.	15	-	15	19
Town Planner	E	B.Sc, M.Sc	30	20	20	25
Builder	F	B.Sc, M.SC, PhD	24	24	24	21
Architect	G	B.Tech, M.Tech	30	12	18	26
Land Surveyor	H	B.Sc.	28	-	28	21
Town Planner	I	B.URP.M.URP	15	15	-	23

Source. Interview 2013.

The first round of interview was exploratory in nature, where in the participants can add more information to the subject matter under investigation (Bryman and Bell 2003) which makes it more appropriate in achieving the objectives, the key variables developed were further validated by 3 key informants who were interviewed using semi-structured interviews which is most suitable and appropriate for achieving the set aim

CRITERIA FOR ENVIRONMENTAL SUSTAINABILITY IN HOUSING DEVELOPMENT

The criteria for environmental sustainability as provided by the key informants ranges from the height of the building ,it should be considered so that it would be easy for the occupants to use ,if lift is provided alternative source of power should also be provided due to the frequent power outage in the federal capital territory ,also provision of easy access and facilities for disable should be provided on a long term basis(sustainable) easy to use ,repair and manage, the design should also be affordable in terms of materials and process, greener areas should be incorporated in to the design, refuse collection and disposal can be used for

compost materials which can be used for power generation ,water supply can be recycle for the use by the same occupants and power for supply, solar energy can be incorporated in the design to provide energy. Which is consistent with findings by Susan and Ahadzie(2013).Lozano(2008 and Majdalam and Lenz(2006).)

CONCLUSION

This research examined the Criteria for Environmental sustainability within housing development in Abuja using qualitative methods. The criteria for environmental sustainability were greener design, affordable building materials, integrating of the design process, refuse collection and disposal ,water supply, electricity supply and provision of alternative source for electricity supply which can be embedded in policy framework to ensure compliance by the Abuja Environmental Protection Board and the Development Control Board.

RECOMMENDATIONS

Contractors and the end users were not included in the Delphi interview which culminated in the development of the survey interview questions. Further research can be carried out to include the exempted stakeholders. As it affects embedding environmental sustainability in the Federal Capital Territory, Abuja.

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A LABOUR OUPUT MODEL FOR BLOCK WORK USING ACTIVITY SAMPLING TECHNIQUES IN GHANA

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ABSTRACT

Labour output is an issue of a particular importance to some of the camping's in Ghana as it is considered a newly developed area and because of the huge amount of projects planned to be carried out in the near future. The purpose of this research is to determined labour output in the construction industry in Ghana. The main objectives of this study were to establish the labour output constants for block work; to find the factors affecting labour output in blockwork; and to compare the research findings to the labour output at the site for block work. Data will be collected using the Delphi and field questionnaire survey. The Structural Equation Modelling (SEM) and Nvivo will be used to analyse data from the field questionnaire survey and Delphi respectively.

Keywords: Labour, Ouput, Model, Blockwork; Ghana

INTRODUCTION

As construction work becomes simpler in recent times, due to the increasing levels of technology and techniques that has introduced in to the industry, the general public continues to complain that the cost of putting up building or house is still high, which is believed depends principally on the cost of material and labour. According to (Bamfo-Agyei and Kotey, 2009) the cost of 'labour are normally be obtained from standard labour constants or from work study were time taken by operative to carry out a task is recorded.

Several construction companies are constantly searching for ways to improve labour output constants in the construction industry. This is because labour is one of the greatest risks in the building construction industry. This must be controlled and continuously improved. Because it is believed those constructions have a process of continuous improvement at site and it is necessary to evaluate this performance. Doing this only in terms of profits, which is the most common way, is not sufficient. Other ways of evaluating site performance is by studying labour output constants using scientific study.

Although the construction industry is faced with a number of problems, several techniques can be put in place to improved labour output constant. Hence this study which is to present action for implementing a work sampling study on selecting job site to enhance work output on a building construction site. From Harris and McCaffer(2001); Since the primary task of construction is bringing favorable condition for management, workforce and resources to effectively and efficiently combine towards raising output constant and quality by achieving a given level of output with fewer inputs, while providing high rewards for those involved. Measuring productivity in the construction site is inherently difficulty due to the labour intensive divers' nature of the industry.

There is no doubt that construction industry is the key in any economic. Due to the increasing level of constructing a building the general public continues to complain that the average cost of designing and building a house is of high cost. Most Building construction companies are trying to generate ways which might improve labour output constants in the industry. It is because labour is one of the greatest risks in the construction sector or industry, which must be controlled and continues improvement of sites and it is necessary to determine this performance. But doing this only in terms of profits which the most common way is not sufficient. Labour costs depend on the squared make up is the numbers of craftsman and labourer's.

According to Harris and MacCaffer (2001) since the primary task of continuation is bringing favorable condition for Management, work force and the resource to effectively and efficiently combine towards raising output constant and quality by achieving a given levels of output with fewer inputs while providing high rewards for those involved. Measuring productivity: In its construction site is inherently difficulty due to its labour intensive, diverse nature of the industry.

RESEARCH MOTIVATION

There is no study on Labour output satisfaction on block work in the construction industry in Ghana, the study hopes to fill this gap in this area. The motivation behind this research is to determine the labour output in block work in Ghana. The research will evaluate the influence of the labour output of block work in predicting the completion time of projects. The factors affecting labour output on site will be considered.

There is a gap that exists in literature on the factors that affect labour output of block work in the construction industry in developing countries. This study therefore contributes in existing knowledge by establishing the factors that establish the labour output of block work activity using sampling techniques and determining the impact on completion time of the construction projects. Instead using existing models as conceptualized for developed countries using instrument such as SERVQUAL factors of labour output satisfaction which have not been considered in previous study will be evaluated as outcome variables. The study will use Structural Equation modeling to analyse and model the labour output in block work activity.
Consequently, the study will add new knowledge on the factors that determine labour output of block work activity in the construction industry in Ghana. The innovative method and the outcome of the variable measures that will be used in the study will contribute to existing body of knowledge.

PROBLEM STATEMENT

In recent years the rate of delays in the construction ‘industry has raised a general concern by the general public to find out what actually is happening considering the basic resources available to construction firms .There is no standard method for determining the financial value of workers daily output. This levels contractors and building owners with the choices of paying huge sums of money or sometimes under paying workers for services rendered. This study is to set the stage for clients, contractors and other professionals in the building construction industry by providing them with labour output constants in the building industry. Amoah-Mensah in 1995 published the data for the output for both skill and unskilled labourers, which is over 20 years due to the span in years this output might not be realistic in the current situation.

Contractor’s construction time and cost depend on the output of the labour but delays in the construction industry have raised a general concern by the public in other to determine actually what is happing. Considering the basic resources that were available to construction industry productivity remains an interesting subject and a dominant issue in construction sector, promising efficient usage of resources and cost saving and ultimately affecting the bottom line of every effort in the construction sector**.** This study is to set the for client, contractors and other professionals in the building industry. (Olomolaiye et al, 1998)

AIM OF THE STUDY AND OBJECTIVES

This research is to establish the labour output for block work using activity sampling techniques. The objectives of the study are:

- (RO1) To identify the factors that determines the labour satisfaction on the construction of block work.
- (RO2) To investigate the current theories and literature that has been published on labour satisfaction and identifies the gaps.
- (RO3) To identify the critical factors that conveys about labour satisfaction and to examine if the factors that determine satisfaction in other cultural contexts, in the same in Ghana.
- (RO4) To evaluate the critical factors that affects labour output of block work in Ghana
- (RO5) To develop a holistically labour output model for block work.
- (RO6) To determine the validity of the conceptualized labour output model for block work.

THEORETICAL VIEWS ON LABOUR OUTPUT SATISFACTION

Labour output is one of the most important issues in both developed and developing countries. Developed countries are aware that productivity is very important for economic growth and social welfare. Developing countries which face unemployment problems, inflation, and resource scarcity and growth rate decline try to utilize its resources in such a way that achieve economic growth and improve citizen's life. Yi and Chan (2014) summarized three main measurements of construction labour productivity at activity, project and industry levels; the major differences between these measurements are the source of data, the level of aggregation, the definition of the production process and the completeness. Hanna et al., (2005) noted that Labor productivity is reflected by the ratio between total product output and total input resource from an economic perspective).Productivity is one of the key measures of utilization of human and financial resources because it is a strong indicator of efficient use of available resources (Hanna et al., 2005). While the economic performance of construction becomes the focus of interest, the gross value or the value added of the production per employee over a certain time period is used to reflect the labour productivity, where the key economic indicators within the construction industry are

collected in order to compute the productivity of the referenced region and time period (Li and Liu, 2010; Chia et al., 2012).

Work measurement

Work measurement is the application of techniques designed to establish the time for an average worker to carry out a specified manufacturing task at a defined level of performance. It is concerned with the length of time it takes to complete a work task assigned to a specific job.

Revealing existing causes of ineffective time through study, important though it is, is perhaps less important in the long term than the setting of sound time standards, since these will continue to apply as long as the work to which they refer continues to be done. They will also show up any ineffective time or additional work which may occur once they have been established.

At the activity level, labour productivity is widely reflected by hourly outputs, where a labour hour and physical quantity of work completed are used as input unit and output, respectively (Hanna et al.,2008). Ma et al., (2016) noted that external factors can barely control the actual physical quantity and working hours, the hourly output measurement of productivity can provide an accurate proxy for construction activity efficiency. At the project level, the aggregation is composed of a series of construction activities with different units of measurements. Therefore, the efficiency of the whole construction process is reflected by the ratio between expected productivity and actual productivity, which is determined by the work days and quantities installed under consideration and practice, respectively Ma et al., (2016).

To provide information on which the planning and scheduling of production can be based, including the plant and labour requirements for carrying out the programmed of work and the utilization of available capacity. To provide information on which estimates for tenders, selling prices and delivery promises can be based. To set standards of machine utilization and labour performance this can be used for any of the above purposes and as a basis for incentive schemes. To provide information for labour-cost control and to enable standard costs to be fixed and maintained. It is thus clear that work measurement provides the basic information necessary for all the activities of organizing and controlling the work of an enterprise in which the time element plays a part. Its uses in connection with these activities will be more clearly seen when we have shown how the standard time is obtained. Cornwell

& Cornwell (2006) assert that, "You can't manage what you can't measure". Measurement is crucial before a management activity is executed. However, it should be noted that an incorrect measurement of labour performance can lead to incorrect and warped decisions by the management team. Therefore, the importance of measuring the right thing at the right time to reflect the true conditions of a company cannot be over emphasized. The measurements should offer the management an opportunity to make effective and accurate decisions. The various techniques available to supply information need to be explored so as to identify the right measurement technique for prevalent conditions. These techniques include: time studies, work sampling, subjective evaluations and) personal recording of activities (Przemeck & Grund, 2008). Many of these techniques have involved over time. Use of technological advances makes it easier to efficiently acquire accurate results.

Time study

Time study is a method used to determine the actual time required to complete a task. It takes into account time allowances and delays. Time studies enable the management to make effective decisions aimed at improving the efficiency of the entities operating within the system. It is important to realize that accurate time studies yield positive results and inaccurate time studies can create many problems (Freivalds, 2009) as mentioned earlier.

Work sampling

On the other hand, work sampling was developed for the first time in 1935 .(Fitzgerald, 2009). Work sampling is the activity of taking randomly distributed observations of activities; these activities can include both humans and machines, with the objective of determining their utilization (Fitzgerald, 2009). The fundamental principle of work sampling is that it is based on the laws of probability (Freivalds, 2009). Work sampling only takes samples rather than continuous observation of the object being studied. This allows for the acquisition of reasonably accurate representations of the work under study, without the drawbacks of continuous monitoring. Work sampling is also observed as a low cost alternative method for determining of workforce utilization (Fitzgerald, 2009). In work sampling, the accuracy of the results is linked to the number of samples taken in the study (Sitting, 2000), as well as the time period during which the analysis is performed. It is, therefore, important that the analyst understands the operations of the company so as to identify an appropriate time frame for the study. The analyst needs to select a sample size that represents the true conditions of the system accurately, while also understanding the

capabilities of the observer. Some standards have been developed to aid in making selections about the number of samples in a study. One such guideline is not to exceed 8 observations per hour (Sitting, 2000). With the understanding that statistical methods form the basis of work sampling, the input data needs to be randomly collected and unbiased (Fitzgerald, 2009). If these conditions are not met the data will not deliver reasonable results. These inaccuracies can include continuity errors (in which small changes in input data represent small changes in the output data), and consistency errors (in which similar runs will not reflect similar results), (Bakker, 2010). Traditionally work sampling does not determine the effectiveness of workers but rather whether they are working or not. It does this by recording the amount of time workers spend on certain activities (Fitzgerald, 2009). Thorough planning needs to be done prior to the start of the work sampling study. The following procedure covers the work sampling process from the objective identification step through to the analysis of the results (Freivalds, 2009).

Activity sampling

Activity sampling is a technique through which information can be obtained not only quickly and economically but also to predetermine levels of accuracy. It is a method that measures the time labour spent in various categories of activities (Thomas, 1991). A sequence of project-based studies were carried out to investigate the factors influencing construction labour productivity, with the purpose of maintaining construction development (Goodrum and Haas, 2002; Jarkas and Bitar, 2012; Loosemore, 2014). Based on a collection of substantial cross-sectional data, detailed insights into construction labour productivity were provided at the project level. The productivity ratio can reflect performance efficiency, where differences between various construction activities can be diminished.

Activity sampling can be defined as a technique in which a large number of instantaneous Observations are made over a period of time of workers, machines, or processes. Each Observation records what is happening at that instant and the percentage of observations recorded for a particular activity or delay is a measure of the percentage of time during which that activity or delay occurs Activity sampling study provides the necessary information to help determine how time is being employed by the workforce, identify the problem area that cause the work delay, and set up a base line measure for productivity improvement. The main advantage of using activity sampling is that it allows a larger number of machines or men to be studied at one time that can be managed using a continuous time study. This leads to a

broader picture of the efficiency of a particular operation than that obtained from a more concentrated but continuous study on a smaller group. Oglesby, (2002) suggested that there are general rules for activity sampling that need to be observed and these are :

a) The observer must be able quickly to identify the individuals to be included in and excluded from the sampling;
b) There should be an equal likelihood of observing every worker;
c) Observation must have no sequential relationship;
d) The basic characteristics of the work situation must remain the same while the Observations are being made.

Activity sampling theory

Activity sampling concepts based on two facts, first fact is a working day can be subdivided into three major parts: productive, contributory, and unproductive time (Oglesby, 2002).

Productive time: time spent in elements directly involved in the actual process of putting together or adding to a unit being constructed.

Contributory time: time spent in elements not directly added to but essential to finish the unit;

Unproductive time: idle time or time spent in not useful or all other elements. Second fact on which activity sampling based is small number of chance occurrences tends to form the same distribution pattern as the whole operation. Thus it is a mathematical technique closely associated with statistics and the theory of probability (Olomolaiye, 1998). Activity sampling being based on a sample of observations must adhere to certain statistical principles and rules to obtain a proper representation of the studied operation. Any sampling carried out should be large enough to be statistically valid – can be used to predict the characteristics of studied operation with a desirable degree of accuracy. The following formula can be used to calculate the required sample size and achieve the specified confidence level and accuracy criteria

$$N = \frac{Z2 \times P \times (1 - P)}{L2}$$

Where:

N = number of observations required;

P = proportion of the total operation being observed;

L = limit (in percentage) of accuracy required; and

Z = standard normal variable depending on the level of confidence.

In construction work, it is generally accepted that 95 percent confidence limits with limit of error of ±5 percent give satisfactory results that can assist in making a real contribution to

increase effectiveness. The value of proportion of the total operation being observed, for construction work usually falls within the limits of 0.40 to 0.6. For construction work, 384 observations are normally accepted as a minimum satisfactory number of observations which allow statistically significant results to be obtained (Oglesby, 2002).

RESEARCH METHODOLOGY

On-site productivity study was conducted on block work activity to determine the time spent in carrying out an activity. Site observations and structured questionnaire were used in this research. Daily visit method of observation of labour productivity was adopted throughout the study. This involved personal observation of labour activities on the selected work on projects. The strategy here was to visit the site daily and interact with the foreman and workers in order to record the dates, number of workers, starting time, closing time and measurement of length/breadth of work done (quantities) of each worker.

The studied population will include 200 contractors who have valid registration from the ministry of works and housing in Ghana. In all a total number of 320 respondents on site 80 of them will be masons; 160 will also be laboueres; 40 contractors and 40 site engineers at the construction site in the ten regions of Ghana will be considered. The study used convenience sampling techniques in data collection; a random sampling technique was adopted to select respondents. The sample was selected randomly from each level of contractor's categories. The contractor's union list is ordered by the company number, one lists of contractors were prepared to represent for only one category. The randomly selection among the lists was done by the researcher using non-replacement random selection.

With this type of research instruments of data collection, first-hand information will be gathered from the study area of the project. The methods the researcher that will be use under the primary methods are; interviews; structured questionnaires and observations. The analysis will be carried out through structural equation modeling which will be used in the development of the labour output model.

Delimitations of the Study

The scope of this thesis focused on labour output of block work on construction sites in Ghana. The study focus on the factors that influence labour output of block work activity of

the construction process. The study was restricted in 10 construction sites each in the 10 regions of Ghana and focused on block work activities.

Ethical Consideration

Ethical issues will be considered in carrying out the study. Respondents will not be forced to participate in the research. The privacy of the respondents will be respected by ensuring confidentiality in not making available identifying information to anyone was not directly involved in the study. The respondents will be anonymous throughout the study.

Overview of study

This study will focus on the background of the study and the problem statement. The aim and objectives will be considered. Research questions will be presented and the research methodology will be stated. The ethical consideration will be clearly stated. This theoretical and conceptual views of literature on labour output satisfaction that will be important in this study. It evaluates a survey of related literatures from books, journal articles and conference papers from relevant sources.

The gaps observed in labour output satisfaction on block work activity which was not evaluated holistically taking consideration of developing countries like Ghana in previous model will be considered. These gaps form the additional new constructs in the current studies of conceptual framework. The gaps that will be identified are the needs and expectations of the workforce and their impacts on the block work activity.

Studies conducted in other Africa countries including Ghana, Nigeria South Africa, Zambia, Kenya, Tanzania and Egypt will be considered in relation to the labour output on blockwork. This will assist to identify other factors that affect their labour output on block work. The development of labour output on block work in South Africa and the suitable model that is used in the country will be focused. The factors that affect the labour satisfaction will be considered and its impact on the construction process.

The methodology that will be used to collect the data of the study will be stated. It will give the sampling technique in selecting the sample size and research instrument used in gathering information from the respondents. Findings from review of literature on existing models on labour output will be discussed. This forms a basis of conceptual labour output model's theory. The hypothesised labour output model will be stated. The findings will be stated based on the said objectives from the questionnaire survey. The analysis and interpretation of result obtained from the questionnaire and discussion on the model will be covered. The conclusion and recommendations of this study will be considered and recommendation for future work will be stated.

CONCLUSION AND THE WAY FORWARD

The long-run trend of the growth in construction productivity at an industry level was explored, suggesting that exogenous technological progress and the existence of capital are the most important factors influencing construction labour productivity changes (Mills 2016). This research has giving insight to other research works on labour output in the construction industry in other countries and the study looked at the Panel error correction models (ECMs) implemented to the data for the Australian construction industry.

The long-run equilibrium and dynamics of construction labour productivity across the Australian states and territories have been revealed. The developed models have been further used to simulate regional construction productivity in order to discover the regional clusters for Australian construction labour productivity. The study will help in developing a model that will focus in forecasting the labour output in Ghana. At the site management level, a daily progress report must include the required information necessary to obtain the baseline productivity. It is strongly recommended to develop a benchmarking standard for each construction firm in Ghana, which may lead to an improvement in the national construction productivity.

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BARRIERS AGAINST CONTRACTORS' ADAPTATION TO ENVIRONMENTALLY SUSTAINABLE CONSTRUCTION PROCESSES

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ABSTRACT

The effects of climate change are devastating to our ecosystem and the global goals of Sustainable Development (SD) have been established to facilitate mitigation and adaptation measures. As an offshoot of SD, Environmentally Sustainable Construction (ESC) processes are important to pursuance of the SD Goals by the construction industry. However, over a decade, establishment of sustainable construction, especially in developing countries, has been a mirage. This paper focusses on understanding why contractors in a developing country have not been able to adapt to ESC processes. Semi-structured face-to-face interviews of built environment professionals in construction companies have been conducted. Thematic template analysis of qualitative data obtained has revealed attitudes and behaviours that militate against environmental resources conservation and regeneration. These present barriers against contractors' adaptation to ESC processes in the context of a developing country. Formulation of regulations and policies to regulate contractors' ESC processes should give prime consideration to socio-cultural characteristics.

Keywords: contracting, environmental impact, organization, sustainability, sustainable development goals.

INTRODUCTION

Global warming of the climate system is no more an anticipated phenomenon but a reality. The report of the Working Group 1 of the Intergovernmental Panel on Climate Change (IPCC) (2013) observed the alarming rising level of carbon in the atmosphere due to unsustainable practices from anthropogenic activities.

> "Warming of the climate system is unequivocal, and since the 1950's, many of the observed changes are unprecedented over decades to millennia" (IPCC, 2013:2).

What makes the climate change a matter worth focusing on by researchers is its devastating consequences to the ecology, which is further pointed out in the report. The report indicates that most aspects of climate change will persist for many centuries even if emissions of CO_2 are stopped. Minimizing aggravation of this situation as well as establishing regenerative sustainability has become very crucial to the survival of the ecology.

Therefore, the shift towards adaptive capacity of the social ecological system needs to be given global attention (DuPlessis, 2014). Bon and Hutchinson (2000), Ofori (1998) and Hill and Bowen (1997) have indicated that economic, framework and resource inequalities exist between developed and less developed countries. These inequalities pose challenge to the establishment of sustainable construction concept. More than a decade after Bon and Hutchinson's (2000) study, other recent studies such as Kaygusuz (2012), Reid (2011) and DuPlessis (2007) still confirm resource constraints challenges facing construction industry stakeholders and rendering them unable to implement sustainable construction practices in developing countries. It will be difficult to overcome these challenges if the capability of stakeholders in the construction industry remains problematic. Within the construction industry, construction contractors remain indispensable stakeholders (Wong, 2013). However, little investigations into the capability of contractors to adapt to sustainable construction have been done. The objective of this paper is to understand why contractors in the context a developing country (Ghana in this case) have not been able to adapt to ESC processes.

LITERATURE REVIEW

Challenges in changing unsustainable construction practices

In most developed countries, sustainable construction practices have advanced (Kibert, 2012; HM Government, 2011). Stakeholders in developing countries need to develop capability for implementing and advancing sustainable construction practices (Ofori, 2012). This is necessary for avoiding retardation of global efforts to achieve global sustainable development goals. Nonetheless, there are challenges encountered in implementing sustainability practices in various organizations in the construction industry.

Opoku and Fortune (2011) have confirmed that a committed leadership in the promotion of sustainable practices in construction organizations is highly imperative. The need to replace traditional practices in construction with modified practices through innovation is also highly necessary for achieving sustainability in construction. According to Kurul *et al.* (2012), delivering sustainability in the built environment sector will require step changes in practice. Practitioners will need to discard long-held beliefs and practices, and thus, transform the built environment sectors across the globe. This draws attention to the fact that professionals' resistance to change or failure to embrace new technologies and innovation in the construction industry pose barriers to adoption of sustainable development principles and

technologies. It is not clear whether these challenges identified, exist as barriers to adaptation to SC in another setting. Therefore investigating empirically, is required to establish and contextualize barriers against adaptation to ESC. Immense pressure is put on the construction and manufacturing sectors to improve traditional practices, which are unsustainable.

Potential Sustainable Construction (SC) barriers specific to developing countries

There are systemic challenges and framework formulation challenges that face the establishment of SC in developing countries to (Kaygusuz, 2012; Ofori, 2012; Reid, 2011; Du Plessis, 2007). The systemic challenges include: uncontrolled rapid rate of urbanization; deep poverty; social inequity; low skills levels; institutional incapacity; weak governance and uncertain economic environment; and environmental degradation. Whether these challenges have strong link with the construction industry and affect the capacity especially that of contractors, to implement SC.

In Nigeria, it has been identified that some of the barriers facing the implementation of sustainable development practices in business firms include:

> "… insufficient employee awareness; inadequate knowledge base on sustainable businesses; lack of experts in the field of sustainable development in firms; corporate and individual indifference to environmental issues; and uncoordinated government policies" (Adegbite *et al*., 2012:86).

These findings were made amongst firms in the oil and gas, telecommunications and banking industries. The specific barriers facing construction industry contractors in Ghana, a developing country, remain unclear. On a national scale, the development agenda of most developing countries are focused on fulfilling survival needs more than meeting the requirements of sustainable development (Sengupta *et al.*, 2003). It is therefore crucial to understand barriers that come against adaptation to SC in order to facilitate devising of strategies needed to empower contractors constrained in developing countries.

Theoretical underpinning for understanding contractors' inability to adapt to ESC

In this paper, the Resilience Theory (RT) (Pisano, 2012; Walker and Salt, 2006; Folk *et al*., 2003), has been adopted to facilitate understanding of the complexities surrounding inability of contractors to adapt to ESC. The RT has been adopted due to its interdisciplinary nature. RT has been used to advance studies in both ecological, social and economic disciplines

(Sarkis, 2010; VanBreda, 2001). The role that anthropogenic activities play, which disturbs the resilience of the ecology, cannot be overlooked. Construction activities that lead to deforestation and emission of Green House Gases (GHG) have high tendencies to push resilience of the ecosystem, as well as social systems within it, beyond bearable limits if not checked.

Carpenter *et al.* (2001) refers to resilience as the ability of a system to build and increase the capacity for learning and adaptation. Other authors' specific definitions of resilience are outlined below:

> "…the capacity to maintain competent functioning in the face of major life stressors (Kaplan, *et al.*, 1996:158)
>
> "…the skills, abilities, knowledge and insights that accumulate over time as people struggle to surmount adversity and meet challenges. It is an ongoing and developing fund of energy and skill that can be used in current struggles" (Gamenzy, 1994, cited in VanBreda, 2001:5)
>
> "… the capacity for successful adaptation, positive functioning or competence, despite high risks, chronic stress, or following severe trauma" (Egeland et al., 1993 cited in VanBreda, 2001:5).

Based on the above definitions, resilience theory, within the context of social system, would demand that an organization, possesses the skills, abilities, knowledge and insights that will enhance its capacity to adapt to ESC. This should happen while the system still maintains its functionality, competence and energy. Folke *et al*. (2010:3) defines social-ecological system as:

> "An integrated system of ecosystems and human society with reciprocal feedback and interdependence."

The definition emphasizes human-in-nature perspective. The construction industry is described as a social-ecological system in view of its interdependent relationship with the environment (Tan *et al*., 2011); natural resources feed into construction activities while wastes and various emissions generated out of the activities of construction organizations are given back to the environment. According to Pisano (2012) humanity depends on services of ecosystems for its wealth and security. Thus, humanity and ecosystems are deeply linked. It

is therefore highly imperative for human organizations to strive for resilient social-ecological systems in order to meet the goals of sustainable development.

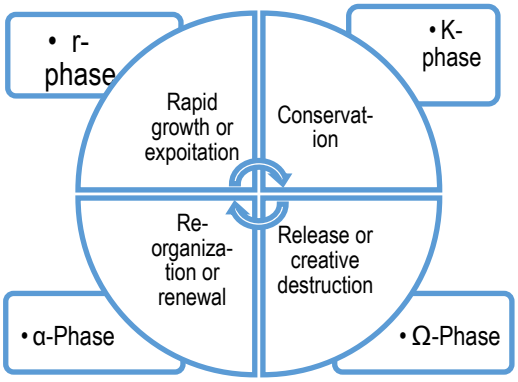

Figure 1 - *Adaptive cycle of a social-ecological system* **Source: Pisano (2012) Walker and Salt (2006)**

Also, an important element of the RT is adaptability or adaptive capacity. This is explained by the adaptive capacity cycle indicated in Figure 1. For a social-ecological system to move from a low adaptive capacity (r-phase) to a high adaptive capacity (K-phase), the resilience alliance, as explained by (Holling and Gunderson, 2002), requires application of K negative feedback strategy. This strategy involves the accumulation of resources. However, it is not clear in literature, whether contractors in the local construction industry are able to apply this strategy in order to increase adaptive capacity for regularizing implementation of ESC processes. Contractors are regarded as actors within the social-ecological system of the construction industry. The focus of this research is on the use of the principles of sustainable development by these actors to ensure efficient environmental management for pursuance of resilient social-ecological system that can overcome adaptation barriers. The ultimate goal of the larger research, which this paper presents a portion, is to find out ways by which contractors can develop resilience to overcome barriers. Therefore, RT, which indicates how a system can achieve capacity to adapt changes, is found to be very relevant in explaining the dynamics that will facilitate provision of guidelines for overcoming adaptation barriers.

> "Resilience is the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks" (Folke *et al*., 2010:3; Walker *et al.*, 2004:2).

Resilience is also known to be the capacity of a social-ecological system to change in a changing world whiles maintaining its functionality (Walker and Salt, 2006). The concept also refers to the ability of a system to resist and recover from disturbances to the ecosystem (Chapin *et al.*, 1996). Thus, the construction industry would need to build capacity in order to conform to the changing construction practices required by ESC principles. This change will be difficult since there will always be barriers. However, there is the need to understand the nature of the barriers that prevent contractors from undergoing the needed change while maintaining functionality. Little work has been done to understand these barriers. Hence, the need to have empirical data from contractors towards understanding such barriers.

RESEARCH METHOD

Purposive sampling and snowball sampling methods were triangulated (Family Health International, FHI, 2014; Bazeley and Jackson, 2013; Nov, 2008; Tansey, 2007; Kumepkor, 2002). This strategy facilitated gaining easy access to appropriate respondents who could speak on the research subject. A semi-structured face-to-face interviews of 24 Built Environment (BE) professional working in 24 construction companies was conducted. Large-scale contractors in Ghana (contractors who are classified as having the capacity to execute building and civil works above US$ 500,000.00) were picked. In Ghana, such contractors are classified as D1/K1 by the Government's Ministry in charge (Tengan *et al.*, 2014). The presence of a BE professional with professional qualification, availability, ability to speak to the issues of the research, were necessary criteria. Other selection criteria included: the construction company having an ongoing project available for observation; usage of heavy construction plant items; and having a defined organizational structure. Since it was difficult identifying contractors who could meet 100% of the selection criteria, snowball sampling technique was also adopted.

Qualitative data obtained from the interviews were analysed using data matrices and thematic template analyses techniques (Volfovsky and Hoff, 2014; King, 2012; Waring and Wainwright, 2008; Nadin and Cassel, 2004). The data matrices facilitated organization of the large volume of qualitative data into manageable matrix of themes and respondents. Before coding and categorizing emerging themes/issues, an initial template, comprising theory-driven codes set *a priori*, was developed. This form of coding was necessary in view of use of theory to understand the research subject. The coding and categorization along emerging themes, are typical analytical procedures for qualitative data (Naoum, 2012).This was

followed by development of a revised template, which comprised of both theory-driven and data-driven codes. Tables 1 and 2 represent the initial and revised templates respectively.

Table 1 - Initial template of codes

CATEGORIES FORMING HIGHER ORDER CODES	THEORY-DRIVEN CODES SET *A PRIORI*
Organizational ESC Adaptability	Adaptability growth stage Organizational flexibility SC modern technologies ESC learning means
Local construction industry characteristics	Locally existing construction technology sufficiency External pressure barriers Local peculiar ecological barriers Local peculiar social barriers Local peculiar economic barriers
Knowledge and skills utilization	Ability to introduce specific changes in unsustainable practices Individual skills utilization to minimize environmental challenges

DISCUSSION OF FINDINGS

Following the coding and categorization, a revised/final template was developed as shown in Table 2. The revision of the template involved; addition, omission and/or modification of the codes established *a priori*.

Table 2 Revised (Final) template of the thematic template analysis

CATEGORIES FORMING HIGHER ORDER CODES	THEORY-DRIVEN and DATA-DRIVEN CODES
Organizational growth and Adaptability	Adaptability growth stage Adaptability regulators Organizational flexibility
Local construction industry characteristics	Modern technology efficiency Efficiency and sufficiency of locally available technologies External pressures Socio-economic barriers
Knowledge and skills utilization	Organizational and individual skills and knowledge Efficiency rate and profit maximization ESC Knowledge acquisition

Other stakeholders roles' in overcoming barriers	ESC modern technology enablers Government Financial enabler role Governmental Legislative/regulatory driver role Social network utilization

Organizational Growth and Adaptability

In the light of the RT, Figure 2 presents a low adaptability level of the contractors involved in this study. This level of adaptability indicates low capacity of the contractors for ESC. This is a situation that heralds rigidity of contractors towards ESC. Moreover, it gives an indication of the existence of barriers militating against flexibility of contractors to adapt to ESC.

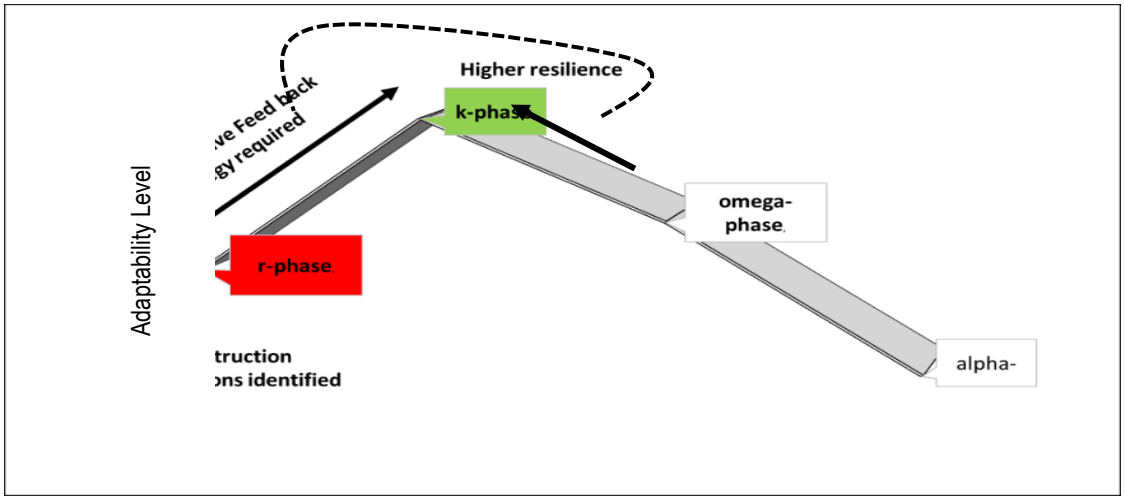

Figure 2 - *Adaptability level of the construction companies*

From the interview data, interviewees demonstrated knowledge about the need to conserve environmental resources through drastic minimization of construction waste. This is an essential principle of sustainable construction. However, this was not the practice observed on construction sites during the interviews. Besides, contractors confirmed absence of specific organizational policy statements on SC. This is an indication of lack of commitment to implement ESC processes. It is observed that the green building principles of reusing, reducing and recycling, as noted by Valente *et al.* (2013), fall in line with the K negative feedback strategy that facilitates conservation of relevant resources of a contractor's organization. Inclusion of such principles in organizational policies would be an indication of commitment to uphold ESC principles as buttressed by (Wong *et al.*, 2011)

Characteristics of the construction industry acting as barriers against adaptation to ESC

Effectiveness cannot be achieved in the efforts made to adapt to ESC without identifying barriers militating against the adaptation process. The identification of the barriers facilitates determination of appropriate strategies to minimize, if not eliminate them. Based on the data available and the postulations of the theories adopted in this study, the framework provides a primary step for contractors to identify barriers preventing adaptation to ESC. Subsequently, action plans for assessing adaptive capacity are provided in the framework.

The lack of amalgamation of construction contractors in the construction industry in most developing countries, such as Ghana, as found by Laryea and Mensah (2010), contributes to the capacity and resource challenges that weakens adaptive capacity. This also gives an indication of the need to create social networks among contractors for fostering adaptive capacity. Figure 3 outlines the different categories of barriers militating against adaptation to ESC.

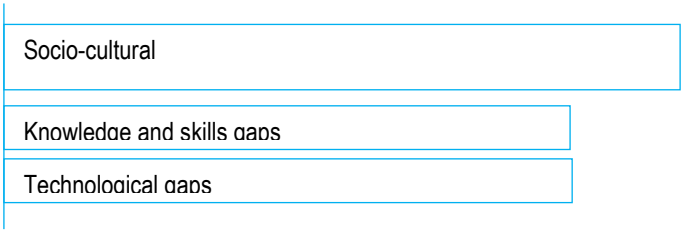

Figure 3 Categories of barriers against adaptation to ESC

From the interview results, the barriers described by interviewees as coming against contractors adaptation to ESC included behavioural and attitudinal characteristics of the culture of workers in the construction industry that do not give less regard to protecting environmental resources. The interview responses indicated that environmental resources in the study country, had been considered by the society to be in abundance; thus conscious efforts to regenerate and protect these environmental resources are not intensified. In the view of respondents, contractors are now gradually recognizing that environmental resources are getting depleted. However, the socio-cultural behaviour towards environmental resources used for construction activities remains do not minimize waste nor regenerate resources. Attitudinal as well as cultural changes are needed to drive regenerative sustainability practices (DuPlessis and Brandon, 2014).

The other category of barriers found in this present research; knowledge and skills gaps and technological gaps, also needs attention. For instance, the knowledge on the use of renewable energy for construction works were not observed during the field study. Interviewees confirmed low knowledge and application of sustainable construction technologies that gives the construction industry the capacity to promote energy conservation. This is an empirical confirmation of Kaygusuz's (2012) assertion about the existence of challenges in the application of renewable energy in developing countries. In this study, this knowledge and technological gap is found as a barrier to contractors' efforts to adapt to ESC processes. Creation of enabling conditions in the local construction industry by other non-contracting stakeholders and allied industries is necessary for overcoming barriers against ESC adaptation.

CONCLUSION

Behavioural and attitudinal characteristics, which do not support environmental resource conservation and regeneration by contractors' organizations, have emerged from this research as barriers impeding adaptation to ESC. Formulation of regulations and policies towards ensuring compliance to SD principles within the construction industry should therefore take into account the socio-cultural behaviour and attitude of the setting for which such laws or amendments are made. Besides, beyond the contractor, other stakeholders have roles to play in minimizing/overcoming these barriers identified. These stakeholders include construction project consultants, clients, manufacturing companies and research and academic institutions. The role of stakeholders such as the academic and research institutions have become crucial in closing the existing knowledge, skills gaps. The manufacturers and suppliers also have roles to play in minimizing/closing the technological gaps. Practicing BE professionals also have roles to play in ensuring that building designs and accompanying contractual arrangements and agreements are also prepared in a manner that will support contractors to implement the principles of sustainable/green building during construction. This is expected to contribute to closing the technical and technological gaps. Further research needs to be directed towards finding out and understanding specific enablers and drivers that need to be created to overcome the barriers militating against contractors' adaptation to ESC.

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UNDERSTANDING THE FACTORS INFLUENCING PRIVATE SECTOR INVESTMENT IN THE POWER GENERATION SECTOR IN GHANA: SYSTEM DYNAMICS APPROACH

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ABSTRACT

One of the major problems facing public infrastructure delivery is funding. The public sector's purse keeps on shrinking as several demands compete for finite resources. Recognising this fact, Ghana in 1997 carried out reforms in the energy sector in order to attract private sector investment (PSI) in power generation (PG). Twenty years after the reforms, Ghana's power sector is still struggling to attract adequate PSI creating power security concerns. The purpose of this paper is to identify and develop a conceptual model of the interaction among the factors that impact on PSI in PG in Ghana. The study draws on interviews of top managers of PG firms to identify the factors and uses system dynamics approach to explain how these factors interact to deter PSI in PG. The factors identified include inter alia, lack of sustainable policy to attract PSI, lack of competition, and low commitment in the implementation of the existing regulatory framework. These factors among others have been used to develop a conceptual model to explain the interaction among the factors in deterring PSI in the sector. The paper provides clearer understanding of the dynamics of specific inhibiters of PSI and can be pivotal in the search for an appropriate strategy to attract the needed PSI in PG. The research provides valuable insights into conceptual basis for a detailed empirical analysis.

Keywords: Ghana, Power Generation, Private Sector Investment, System Dynamics

INTRODUCTION

The provision of electricity is the sole responsibility of governments (Sindhu et al., 2016). However, the ever increasing demand for social services coupled with the limited budgetary constraints of governments make it extremely difficult for the public sector alone to provide this critical economic resource (OECD, 2007). This occasioned the reforms that occurred in the power sector (PS) across various continents in the early 1990s. The reforms resulted in a massive PSI in the PS in various countries. The reforms in Africa, however, have not translated into similar investments in the PS leading to high instability of power supply - power rationing and unplanned outages in most African countries (World Bank, 2010). Ghana Grid Company (GRIDCo) (2010) reports that Ghana is losing 2 – 6 per cent of Gross Domestic Product (GDP) per annum due to erratic power supply. The poor power supply is

attributed to under investment in PG. The World Bank (2011) estimates that an additional 2400MW of generation would be required by 2020. This implies that the existing generation capacity would have to double by the said date. Even though efforts have been made to attract PSI in PG through government guarantees to private PG firms, the response has not been encouraging despite high interest being shown by these firms.

The conundrum is, why has the reforms process in Ghana and the rest of Africa not culminated into PSI in PG? What are the deterrents to PSI in PG in Ghana? How does the factors that impede PSI in PG interact? The purpose of this study is to answer these questions through the identification and analysis of the interaction among the factors that influence PSI in PG in Ghana. Even though some authors such as Ghana Millennium Challenge Account Program (GMCAP) (2012); Amoako-Tuffour and Asamoah (2015); and Fritsch and Poudineh (2016), have attempted to diagnose the challenges confronting the power sector, the relationship between the factors and PSI has not been the focus of these authors. Also, system dynamics methodological approach, to the best of our knowledge, has never been applied in analysing PSI in PG in Ghana nor other parts of the world.

LITERATURE REVIEW

Investment comprises resource allocation for medium or long-term with the goal of recovering the investment costs and also attain a high profit (Virlics, 2013). Investors acquire asset purposely to increase its value (Aubrey, 1995) through profit making. To achieve this, investors will always evaluate returns against risks associated with a given investment, and will opt for an investment that offer higher returns for a given level of risk (Aubrey, 1995). Risk and returns on investment are therefore fundamental determinants of investment (Wustenhagen and Menichetti, 2012). For example, Gamel et al. (2016) found that return on investment influences individuals' decision to invest in renewable energy (RE). Therefore attracting PSI largely dependent on policy markers' ability to eliminate those factors considered as a threat to the achievement of reasonable returns on investment (Wustenhagen and Menichett, 2012). Researchers and infrastructure funding agencies have therefore dedicated time and resource to identify such factors to engender PSI in PG.

A survey of extant literature reveals a renewed interest in PSI in the power sector (PS). Authors in recent times have turned their attention on issues that influence investment in PG. A number of factors have been identified across different countries or regions as either

promoting or inhibiting PSI in PG. Most of these findings seem to put governments and for that matter policy in the driving seat to attract PSI in PG. For example, Medina et al. (2015) investigated barriers to PSI in Solar in Morocco using scenario analysis. They revealed that reduction of the uncertainties and informalities as well as easing of financial and legal barriers would be key to promoting PSI in Morocco. Kathuria et al. (2015) compared state level institutions policy difference and its impact on foreign direct investment (FDI) in wind energy in India. A strong correlation was established between policies such as feed-in-tariff, open access transmission, third party sales, and wheeling charges and FDIs in India. Also, Vagliasindi (2012) examined key drivers of public-private partnership (PPP) in developing countries with emphasis on paradigm shift from fossil fuel to RE. The author analysed 105 developing countries from 1993 to 2008 and revealed that PSI and even the level of investment in RE are driven by supportive policies such as feed-in tariffs, anti-corruption policies and degree of political competition. From the foregoing, it can be argued that factors that inhibit PSI in PG are not limited to the sector specific policies but are also impacted by wide governance and political factors. More importantly, these studies have narrowed on RE and their findings may not be applicable to other technologies.

The role of market structure to the promotion of PSI have also featured in several studies. Lock (1995), for example, highlights the relationships between industry structure, competition, market mechanisms and regulation, and PSI. Botterud and Doorman (2008) established that electricity markets have serious impact on generation capacity adequacy whilst Doorman et al. (2007) observed that electricity markets restructuring affects investment in PG. The International Energy Agency (IEA) and the Organization for Economic Co-operation and Development (OECD) (2003) examined and established a correlation between risks, electricity markets and price instability, and PG investment in liberalised electricity markets. It is therefore expected that with the reforms in the Ghana's PS from a monopolistic market to a liberalised one, there should have been a corresponding PSI in PG. Sadly, this has not been the case.

IEA and OECD (2007) report on how investment challenges in PG in IEA countries could be tackled. The report recommends stable and competitive investment framework that sufficiently reward investments; reduce investment risks; pursue competitive markets; establish transparent (clear, coherent, and fair) market rules by independent system operators and regulators; avoiding price caps; and implementing clearer and more efficient procedures

for approval of new power infrastructure. Gross et al. (2007) investigated and established a relationship between costs, incentives and risks, and investment in generation in the United Kingdom. They argued that policy goals must be designed with risks as well as costs in mind, and that the effectiveness of the incentive schemes would determine to a large extent the achievement of policy goals. Fritsch and Poudineh (2016), using secondary data, investigated the impact of the domestic gas production on the performance of the electricity sector in Ghana. Their findings on the challenges of the PS corroborates earlier findings of GMCAP (2012), World Bank (2013) and Amoako-Tuffour and Asamoah (2015). These studies fall short of examining the interaction of the challenges identified. This could badly affect effectiveness of the policy proposals recommended by these earlier studies. The refusal of previous authors to see the PS as a system and the factors identified as dynamically complex, could result in myopic prescription thereby reinforcing the existing problem.

THEORETICAL FRAMEWORK

System thinking (ST) is a theory that gives decision makers the leverage to identify root causes of problems and new opportunities available (Meadows et al., 2008). This approach of problem solving is distinct from the traditional approach, in that, it takes a broader perspective of problems by widening its horizon to cover larger interactions (Aronson, 1996). The view of ST is that most social problems are dynamically complex, and any action taken to resolve them generates feedback (Ibid). The interdisciplinary nature of ST has led to its wide application across different fields. It is particularly effective in resolving recurring problems or those that have been made worse by past attempts to fix them; problems where an action affects or is affected by the environment surrounding the issue, either the natural environment or the competitive environment; issues involving several actors; and problems whose solutions are nonlinear (Aronson, 1996). The theory assumes that several causes routinely come together to generate many effects. However, oftentimes, managers tend to perceive single causes producing single effects leading to defective prescription of solutions to problems.

This study adopts the system dynamics (SD) an approach under ST. SD is a powerful tool capable of resolving highly complex systems comprising nonlinear relationships with multiple interdependencies (Boateng et al., 2015). The central concept of SD is to understand how the parts in a system interact with one another and how a change in one variable affects the other variable over time, which in turn affects the original variable (Senge, 1990). One of

the cardinal merits of SD approach is rooted in its ability to present a problem in a manner that affords managers better understanding and diagnosis, and also model the interaction among information, actions and consequences for holistic prescription of solutions (Coyle, 1996). Consequently, it pays close attention to feedback process that arises within a project structure (Rodrigues, 2001) and presents different parts of a system with mathematical equations which are simultaneously resolved with the aid of computers (Brockmann, 2007). Even though SD has been employed in diverse fields including the power sector, its application in understanding the factors that influence PSI is not conspicuous.

RESEARCH METHODS

This study aims at providing a better understanding to the factors that impact on PSI in PG. It employs qualitative strategy with interviews as the main tool for the data collection. Directed content analysis is used to analyse and identify the factors. Using SD the content analysis result has been used to develop a conceptual SD model. Through a visit to the Energy Commission, all private PG firms were identified and contacted for inclusion in the investigation. Only firms whose projects have reached construction stage and beyond were included in the investigation. A total of six firms including: Takoradi International Company; Sunon Asogli Power (Gh) Limited; Cenpower Generation Company Limited; CENIT Energy Limited; Ameri (Metka) Ghana Limited and Amandi Energy Limited consented to participate in the study and their top management were therefore interviewed. In all, three Chief Executive Officers and three top managers were interviewed. The questions asked hinged on the specific challenges of the projects; factors associated with the existing regulatory and institutional framework; market design; power pricing; demand side; and technical standards and how these factors are affecting PG business. Themes/clusters were predetermined through literature. Factors emanating from the transcribed data were then grouped under the themes.

SD approach allows systems to be modelled using both qualitative and quantitative information. Luna and Andersen (2003) opined that, even though SD employs mathematical equations to represent problems and policy alternatives, majority of the data available to researchers and decision makers are non-numerical. As observed by Forrester (1994:74) that the size of information shrinks as it is converted from mental to written and reduces further from written data base to numerical. The assertion of Forrester (1975) that qualitative data is the main data source available for SD modellers, and supported by Sterman, 2000 is therefore

noteworthy. Luna and Anderson (2003) emphasised that qualitative data and their analysis are pivotal in SD modelling process, and is indeed possible to use qualitative data for SD models even though some authors perceive models from qualitative data as fragile and could be misleading (Coyle, 2000).

Luna and Andersen (2003) assert that while quantitative data is useful for the development of feedback models, qualitative data is advantageous in bringing deeper understanding in the dynamic interaction among the elements of a system. Coyle (2000) emphasised that, "qualitative modelling can be useful in its own right and that quantification may be unwise if it is pushed beyond reasonable limits". According to Sterman (2000) "Omitting structures or variables known to be important because data are unavailable is actually less scientific and less accurate than using your best judgement to estimate their values". The use of qualitative data for the conceptual SD model in this paper is therefore not alien to SD application, hence its adoption in this study.

RESULTS AND DISCUSSIONS

The results of the interviews revealed a number of factors attributed to the low participation of private sector in PG. These are classified under macro-economic; institutional and regulatory; policy; third party; market design; and political and governance factors as presented in Table 1. The economic environment in which a sector operates will have some influence on profitability and for that matter PSI. Macroeconomic factors cited by respondents as impacting on PG companies in the country include the difficulty in accessing foreign exchange for the importation of spare parts and other consumables; instability of the macroeconomic environment leading to high inflation and depreciation of the currency. High public debt which has led to the introduction of several taxes was also mentioned as an inhibitor to PSI. Unstable inflation, high interest rates, and scarce foreign exchange have serious financial risks on investors' ability to pay their debt and earn reasonable return on their investments.

The study identified a number of factors affecting PSI which are associated with the existing regulatory and institutional framework governing the PS. The interviewees mentioned factors which have to do with principal agents' problems. The regulatory institutions are under high political influence which compromises their independence and affect their ability to apply the set rules. The existing regulatory structure though underdeveloped are considered adequate and generally good contrasting previous findings. However, the refusal to adhere to these

rules is rather considered as the main impediment to PSI. Further, the respondents also bemoaned the lengthy licensing process, and attributed same to the numerous agencies involved in the process. Similar findings were reported by the World Bank (2013).

Policies have been used globally to either incentivise or deter investments in critical sectors. They are a function of PSI (Cambini et al., 2016) and could therefore be a threat to investors (Polzin et al., 2015). The interviewees cited lack of sustainable policy directed towards the attraction of PSI. Similarly, even though there are short term sector development plans, it is believed that long term plan will have resolved the issue of unreliable fuel source, which was considered by the respondents as one of the major deterrent of PSI. A number of factors were mentioned by the respondents and were accordingly classified under third party factor cluster. These factors are mostly emanating from the off-takers' inability to perform their bargain of the Power Purchase Agreements (PPA). Indeed, most of the factors under this cluster have been reported by previous authors such as Fritsch and Poudineh (2016).

Table 1: Factors influencing PSI in PG in Ghana

Cluster	Cluster Factors
Macro-economic Factors	Scarcity of Foreign exchange Bad structure of the economy Unstable macro-economic environment Exchange rate instability High public sector debt High taxes
Institutional and Regulatory Factors	Lack of Independence of the regulators Lack of level playing field Evacuation and permitting regimes Lack of a central body Unpredictability of the application of the rules Lack of proper systems to implement tariffs Prolong licensing period Entry difficulties Non-applicability of the automatic tariff adjustment Institutional structures not developed Numerous agencies in the decision making process Lack of standard approach/clear guidelines in dealing with IPPs
Policy Factors	Government subsidies Lack of sustainable policy to attract private sector Lack of long-term sector development plan Under investment in the sector *Ad hoc* manner things are done Unreliable fuel source Difficult to receive Government Consent and Support Agreement (GCSA) Long lead time to reach financial close
	ECG unable to collect bills Government refusal/inability to pay its bills Non-payment of power used by consumers

Third Party Related Factors	ECG inability to raise guarantee Poor financial balance of ECG/VRA Lack of credible off-taker Delayed payment Poor liquidity of the off-takers Ageing transmission & distribution network Corrupt ECG staff High commercial losses High Technical losses Lack of stakeholders support VRA inability to purchase fuel for generators Uncertainty
Market Design factors	Weak structures to support PSI Lack of competitive market State domination Ineffective workings of the whole value chain Slow decision making process Lack of robust bidding framework to drive efficiency and cost
Political and Governance Factors	Political influence Land Acquisition difficulties Lack of standard PPA Poor sector management Politicisation of the sector Corruption Lack of transparency in awarding power deals

Even though generation has been unbundled from transmission, the respondents believe that the sector is highly dominated by the state; and that the structures developed to support PSI are weak; and that the whole value chain is not working effectively. The quasi-single buyer market has entrenched non-competition at all levels of the market and was cited as a barrier to PSI.

Most of the problems facing the Ghanaian power sector have been attributed to political and governmental influence. The PG firms interviewed seems to agree on the fact that the politicisation of the sector, leading to political influence in power pricing and subsidies, never been fully paid is the cause of most of the challenges the sector is grappling with. Corruption and non-transparency in the award of power deals were also
mentioned as affecting PSI in PG in Ghana.

CONCEPTUAL SYSTEM DYNAMICS MODEL

The results of the interviews presented in Table 1, have been used to construct a conceptual model presented in Figure 1 using SD methodological approach. It is understood that this model provides a partial understanding of the sector dynamics. The causal loops will be better appreciated using computer simulation after the weights of the variables have been

determined which is outside the scope of this current study. The arrows connecting two factors show influences between them; the plus or minus sign indicates that, all things being equal, a positive change in the preceding factor has a positive or negative effect on the succeeding factor. Thus, for example, if high commercial losses on the part of the off-taker were to increase, as it is the case of Ghana's power sector, it will result in a further weakening of the off-takers' balance sheet, which in turn leads to further delay in payment to generation firms thereby affecting their rate of returns on investment and ultimately affecting PSI decisions in PG. Besides, several 'positive' or 'reinforcing' loops and 'negative' or 'balancing loops' are scattered across the entire model. Causal loop with odd number of negatives on the arrows indicate a 'balancing loop' or self-regulating feedbacks (represented in the model with 'B') and those with even number of negatives or where the polarity are all positive shows a reinforcing loop (represented in the model with 'R') i.e. the original problem may be amplified. The model contains six subsystems and one hundred and forty-six feedback loops. The complexities of the system coupled with space limitation make it impossible to discuss all the feedback loops. Hence, discussion of some loops in at least each subsystem has been done.

The conceptual model showing the causal feedback loops, describes the relationship between prevailing factors; policy, institutional and regulatory, macroeconomic, market design, third party and, governance and political factors and their impact on investors' rate of return and risks associated with power plants investment. The inputs to the SD model are the various factors under the captioned clusters shown in Table 1 and the output being either reduction, increase or stagnation of PSI in PG.

The macroeconomic subsystem comprising public debt, exchange rate stability, availability of foreign exchange, structure of the economy, tax rate, and macroeconomic environment have adverse impact on other subsystems producing chain effect resulting in heightened perception of risks thereby culminating in to low PSI in PG. For example, public debt is impacted by government subsidy policy and other factors outside the model boundary. This affects government's ability to invest in the sector leading to over-aged transmission and distribution network which also influence the technical efficiency of the network resulting in poor financial balance of the main off-takers. The poverty of the off-takers affect investment in network and payment to generation firms thereby adversely impacting on expansion of generation and also sending negative signals to would-be investors resulting in low PSI.

Several other variables and loops interact with the described loop producing a complex interaction and feedback. These interactions produce an aggregate impact which far exceeds the effect of a single variable. The longest loop in the macroeconomic subsystem i.e. public debt, scarcity of foreign exchange, exchange rate instability to macroeconomic environment, is a reinforcing loop producing vicious cycle of effects leading to cascading of problems due to positive feedback.

The third party subsystem is characterised by several reinforcing loops indicating some kind of oscillation. A given change kicks off a series of changes that cascade through other factors and subsystems in order to amplify the existing challenge. However, the financial health of the off-takers affect their ability to raise guarantees such as letters of credit, which impact greatly on their credibility at all fronts. Financial balance forms a balancing loop with technical losses and reinforcing loop with off-taker's credibility. This implies that when the financial health of the off-takers' is improved, it would lead to a reduction in technical losses. Additionally, positive feedback loop exist between financial balance and off-takers' credibility as indicated in Figure 1.

Furthermore, the regulatory and institutional related factors such as licencing period, multiplicity of agencies involved in licencing, lack of standard approach in dealing with IPPs, and the lack of regulatory independence, interact among each other and with other subsystems such as governance and political subsystem to produce rippling effects on PSI in PG. For instance, several factors affect the easiness with which a would-be investor would enter the PG market. The entry difficulty produces positive feedback in the form of corruption and vice versa. Also, the issue of lack of independence of the financial regulator was highly mentioned as a serious challenge to the survival of most of the PG firms as well as the distribution and transmission companies. This is evident in Figure 1 where the political influence, regulator's independence, applicability of the automatic tariff adjustment formula and politicisation of the sector form a reinforcing loop. This loop produces a snowballing effect, worsening the already precarious situation of the sector contributing to an unprecedented electricity crisis spanning from 2012 - 2016.

The conceptual model presented suggests that, the variables within the PG sector are highly interlinked. The regulatory and institutional framework, policies, government and political interventions, macroeconomic environment, market design as well as third party actions and

inactions influence the behaviour of the industry players, especially investment decisions. Actions meant to regulate the industry should therefore be taken with caution since one decision may lead to unanticipated consequences.

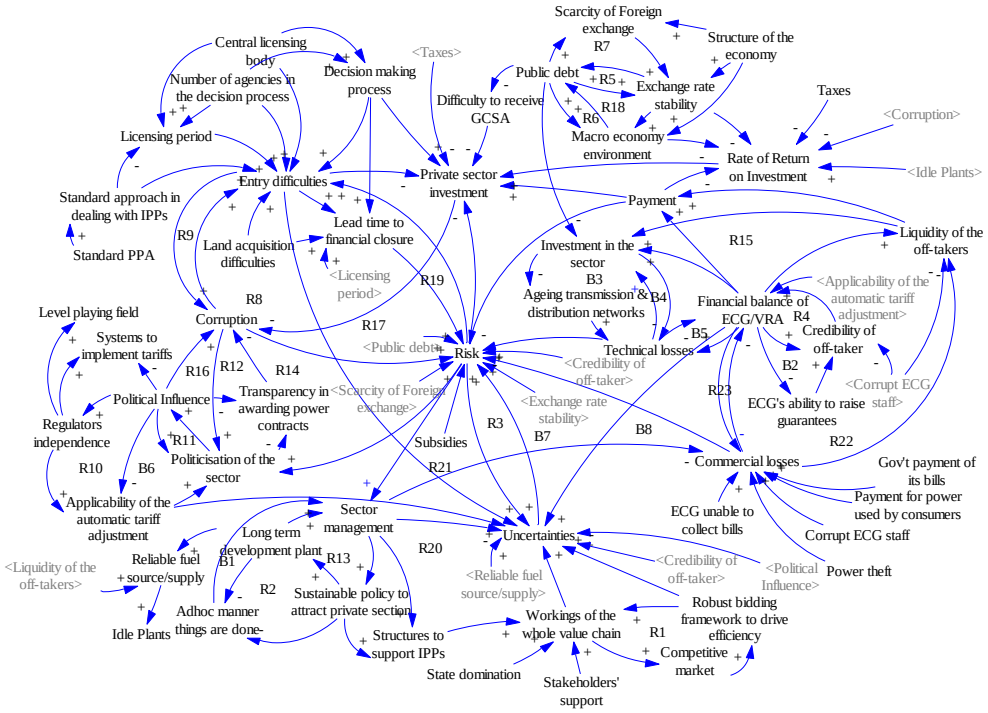

Figure 1 - *Conceptual Model of Factors Influencing PSI in PG*

CONCLUSION

This research paper has systematically identified and analysed the interactions of various factors that impede PSI in the PG sector in Ghana. The analyses show that individual factors do not act in isolation, but in a web of complex interaction to produce far greater impact which also affects the rate of return and the perceived risks on the project. The cause-effect SD model developed in this paper is useful in analysing the entire PS to produce insightful results. Further, the analysis reveals the extent to which individual factors respond to network of lower level factors, and therefore useful to inform policy decisions. Even though this paper is short of parametric figures, the trends of the dynamic interactions are the best indicator for understanding the behaviour of a system and not the parameter values and simulation output (Ogunlana et al., 2003).The understanding generated by the paper will influence future policies to ensure that, investor friendly policies are not only formulated, but a systemic approach is adopted and a holistic prescription is offered to address the problem in its

entirety. The main limitation of this study is that the model is yet to be validated and should therefore be applied with caution.

Future Research Agenda

To ascertain the actual impact of the individual factors and their combined effect, next phase of this study will be to determine the extent to which the identified variables impact on PSI using the Analytical Network Process (ANP) and stock and flow model of SD.

Acknowledgement

This paper forms part of an on-going Doctoral research project entitled 'System Dynamics Model of Factors Influencing Private Sector Investment (PSI) in the power Generation Sector of Ghana' fully funded by the Deutscher Akademischer Autausch Dienst (DAAD) and the Government of Ghana

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FACTORS THAT AFFECT THE USE OF PERSONAL PROTECTIVE EQUIPMENT ON GHANAIAN CONSTRUCTION SITES

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ABSTRACT

This study is part of a broader study into the use of Personal Protective Equipment (PPE) in the construction industry in Ghana. The study investigates the factors that contribute to the reluctance or failure of workers to use PPE. Primary data were collected by the researchers via a questionnaire survey of 123 site workers selected from construction sites which were active with at least 50 operatives, had a high probability of encountering the types of hazards identified in literature and above all, sites that encouraged the use of PPE by workers. The findings of the study suggest that construction workers in Ghana are aware of the importance of PPE but some fail to use them because of discomfort, interference with work, lack of knowledge of how to use them, and failure of some employers or their agents to supply them. The implications of these findings are that every effort must be made by stakeholders in the PPE supply chain to take steps to minimise the discomfort suffered by employees and to make them less intrusive. It is also important to enforce existing regulations which make it mandatory for employers to provide PPE and for workers to use them.

Keywords: Personal Protective Equipment (PPE); Ghanaian construction industry; construction workers

INTRODUCTION

The construction industry continues to record high occupational accidents worldwide. The industry employs about 7% of the world's population and yet accounts for 30-40% of global occupational accidents (ILO 2005). In many developing countries, accurate statistics of injuries and fatalities in the construction industry are virtually non-existent due to poor recording and notification systems. Ha¨ma¨la¨inen et al, (2006) argues, that in spite of this, figures obtained are still used as a "baseline for occupational safety work".

Available data would suggest that accident rates in developing countries are 3–6 times greater than in the developed countries (Jason, 2008). For example in Ghana, the number

construction industry accidents recorded in 2004 was 8. This rose to 28 in 2009, an increase of 250 per cent over a period of 5 years (Nimo-Boakye et al, cited in Fugar et al, 2010). Considering the fact that most construction accidents are not reported, the rising trend found in the few reported cases gives good reason for grave concern about safety on construction sites in Ghana.

Kheni et al, (2006), attribute the poor health and safety performance of developing countries to a low use of technology, labour intensive methods and low workforce participation in health and safety issues. The ILO estimates that the cost of work-related ill-health and accidents amounts to 4% of the world's Gross Domestic Product (GDP) or 1.25 trillion US dollars. This estimate is based on a selected compensation system and is probably an underestimate due to the under-reporting of many work-related illnesses.

Research suggests that health and safety in construction is better managed when all stakeholders, that is, the client, the designer, the contractor and construction workers, each play their specific roles in this regard. Huang and Hinze, (2006) observe that efforts made by project owners to manage health and safety has shown to favourably influence project safety performance by setting safety objectives, selecting safe contractors, and participating in safety management during construction. The authors further describe the high levels of economic losses incurred through accidents, owners having to bear final accident losses and third-party legal proceedings against owners as the three main reasons which define the need for owner involvement in construction safety. Designers of construction work cannot be left out of safety discussion. OneyYazici and Dulaimi (2015) observe that in recent times, researchers and practioners consider site safety as a design criterion. Designing for site safety is currently seen as the foremost method of eliminating construction hazards (Gambates, Behm and Ranjendram, 2008). Ahmed and Azhar, (2015) argue that even though construction organizations can improve safety by providing the necessary systems, tools and motivation to eliminate hazards, safety is actually implemented, in essence, by construction workers on work sites, through the adoption of adequate safety related tools, equipment and systems for the provision and control of the work environment and human behaviour. Perhaps this assertion is supported by Abdelhamid and Everett, (2000), who attribute the major causes of construction accidents to human behaviour, difficult work site conditions, inadequate use of protective equipment, and poor safety management, which result in unsafe work methods, equipment and procedures. In addition, workers' refused adherence to work procedures (Che

et al., 2007), or irresponsible behaviour of the workers themselves or complete refusal to use the appropriate equipment or wear personal protective equipment (Fugar et al, 2010), result in many of the accidents that occur on construction sites.

Often overlooked and mostly considered as being only a minor player in the overall site safety, PPE can be a significant determining factor between an accident and safety. Anecdotal evidence suggests that wearing the correct personal protection at all times is extremely important in reducing accidents and should be given high priority. This is not to assert, of course, that safe work practices should be given any lesser priority (Ahmed and Azhar, 2015).

Personal Protective Equipment (PPE) Use and Construction Workers

Personal Protective Equipment may be described as anything worn or held by a person that protects him against one or more risks to his health or safety. Personal protective equipment may include items such as hand gloves, safety goggles, safety shoes, earplugs or muffs, hard hats/ helmets, respirators, nose masks, high visibility reflective jackets ,overalls, vests and full body suits.

Although it falls at the bottom of OSHA's hierarchy of organizational safety control, PPE is necessary as a supplementary method of control when exposure to hazards cannot be re-engineered, are completely out of normal operations or maintenance work, and when safe work practices and other forms of administrative controls cannot provide sufficient protection to employees. The Labour Act, 2003 (Act 651) of Ghana, mandates workers “to use safety appliances, fire-fighting equipment and personal protective equipment provided by the employer in compliance with the employer’s instructions” (Section 118:3, cited in Fugar et al, 2010).

In an investigation on the state of health and safety on construction sites in Ghana based on a study of specific cases (construction sites), Laryea (2010) identified the primary reasons for the existing poor state of health and safety on Ghanaian construction sites as a lack of strong institutional framework for governing construction activities and poor enforcement of health and safety policies and procedures. Similarly, in his assessment of the influence of contextual environment on health and safety practices in the Nigerian construction industry Umeokafor, (2015), presented a poor health and safety regulatory system, a lack of governmental

commitment to health and safety, corruption, beliefs and values of construction workers as accounting for the poor safety performance of the Nigerian construction industry. Laryea (2010) reports that Site Engineers who double as site safety officers on some construction sites sometimes refuse to provide PPE for workers even when there are specific contractual requirements. On other construction sites, workers refuse to use PPE provided due to inadequate induction. Other workers have to be forced to use PPE. "We normally provide them with this – we give the masons helmet and safety boots – however we have to force them to wear the PPE" (Laryea, 2010).

In Turkey, a great number of deadly occupational accidents occur on many construction sites because workers do not make use of PPE and safety education (Yilmaz, 2014). In his report, the lack of use of PPE by construction workers is the second most common (i.e. 12%) cause of construction accidents. In another study conducted in the United States, fifty-eight percent (58%) of workers interviewed stated being uncomfortable as the main reason for not wearing PPE. Thirty - Eight percent (38%) indicated stress problem in wearing PPE particularly in hot, sunny weather, confined and poor ventilated areas (Ahmed and Azhar, 2015). These phenomena are not different in Nigeria as identified in a similar study by Tanko and Anigbobu (2012).

The reluctance of construction workers to use PPE is worrying considering the fact that needless accidents could be prevented on construction sites. According to Tanko and Anigbobu, (2012), PPE use is quite irrelevant in construction safety discussions in developed countries, a result of the fact that safety regulations have developed there, and there exists a legal framework for enforcing those regulations. The researchers further mentioned that "while personal protective equipment should be the last resort in the safety controls put in place by an employer, In Africa however, it is, also our own first, personal, line of defence against the hazards we come across at work. This is especially true in many developing countries where PPE might often be the only line of defence against hazards on construction site".

RESEARCH AIM AND OBJECTIVES

The aim of the study was to identify the reasons for which Ghanaian construction workers would not use the requisite PPE on construction sites, as a preliminary study for an on-going doctoral research.

The research objectives that guided the study are outlined below:

1. To identify hazards present on construction sites in Ghana.
2. To outline the types of PPE present on construction sites to mitigate the effects of the hazards
3. To identify the challenges faced by construction workers in Ghana in the use of the outlined Personal Protective Equipment.

METHODOLOGY OR RESEARCH APPROACH

Information for the study was obtained through the administration of a structured questionnaire to construction operatives on selected construction sites. The construction sites were selected through the non-probability sampling technique of purposive sampling, with selection criteria such as an active site with at least 50 operatives, a site that has a high probability of encountering the types of hazards identified from literature and a site that promotes the use of PPE by workers.

Respondents were selected through convenience sampling on the sites visited. The number of respondents per site varied depending on the population of operatives per the site and the trend of responses received from that site. One hundred and twenty-three (123) questionnaires were personally administered to site operatives, consisting of masons, carpenters, steel benders, electricians, plumbers, painters and labourers. 79.3% of respondents were skilled artisans while 20.7% were unskilled labourers. Construction workers, who took part in the study, answered the questions of their own accord, and not in the presence of their supervisors. Descriptive statistics was used to describe the data obtained from the questionnaire survey using the IBM SPSS v. 21 software tool.

This study precedes an on-going doctoral research. This method of data collection was chosen because it is simple, economical and expedites the collection of data (Ferber, 1977)

Summary of Findings

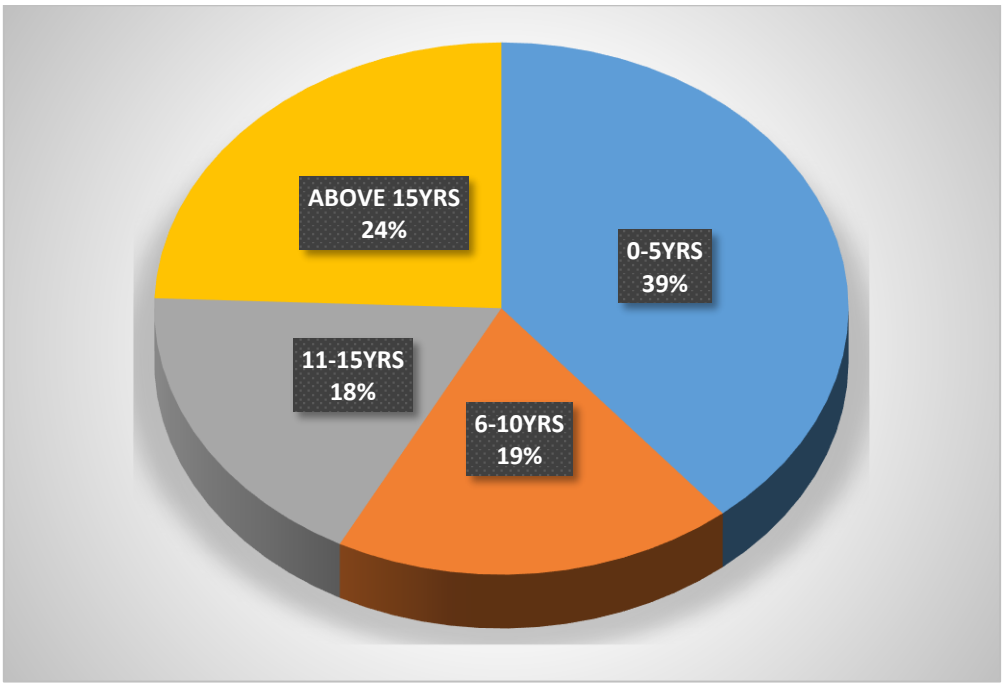

Figure 1 - *Work experience of respondents*

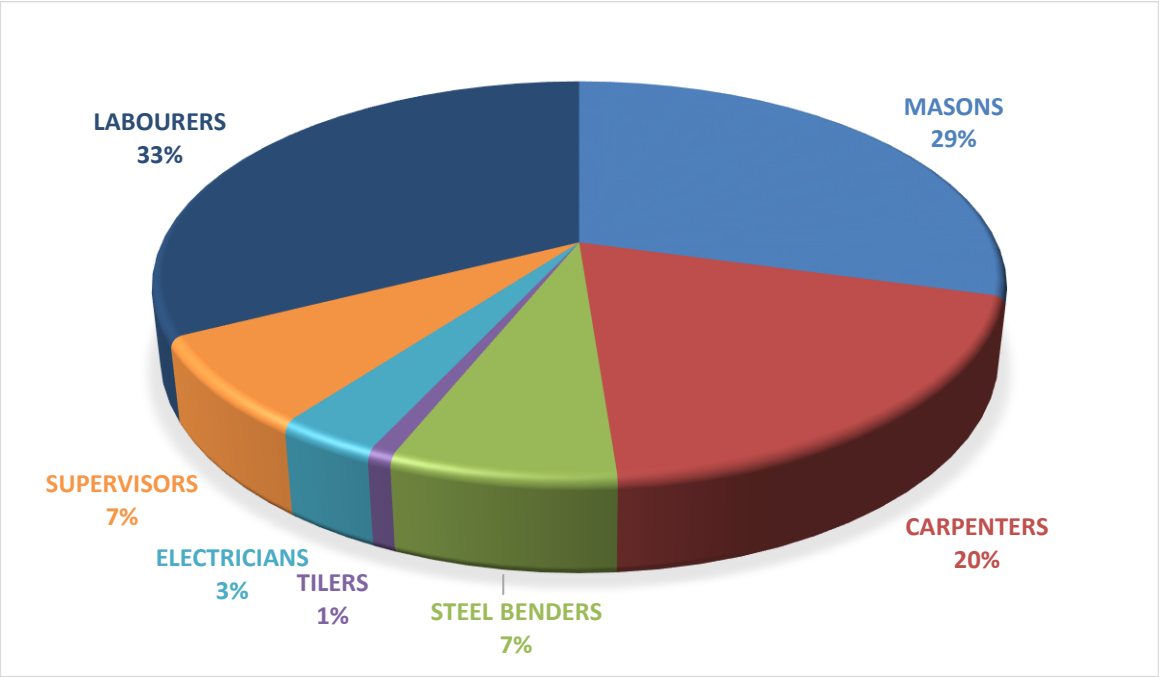

Figure 2 - *Expertise profile of respondents*

Table 1: The use of PPE on construction site

TYPE OF PPE	DOES THE COMPANY PROVIDE PPE		DO YOU USE PPE PROVIDED	
	% YES	% NO	% YES	% NO
HELMET	83.20	16.80	78.60	21.40
SAFETY GOGGLES	58.80	40.30	55.90	43.20
NOSE MASK	54.60	44.50	48.30	50.00
EAR PLUGS	41.20	58.00	33.90	65.30
REFLECTIVE JACKET	77.30	22.70	67.50	31.60
HAND GLOVES	68.10	31.90	65.00	34.20
SAFETY HARNESS	47.10	52.90	40.70	58.50
SAFETY BOOTS	68.10	31.90	72.40	27.60
AVERAGE	62.30	37.38	57.79	41.48

Table 2 - *Reasons for Non-Use of PPE on construction sites*

TYPE OF PPE	I FEEL UNCOMFORTABLE	I DO NOT KNOW HOW TO USE IT	IT GETS IN THE WAY OF WORK	IT IS NOT RELEVANT TO MY WORK	I WAS NOT GIVEN ONE	NO REASON
HELMET	49.00	2.00	11.80	0	37.30	0
SAFETY GOGGLES	32.80	1.60	11.50	0	54.10	0
NOSE MASK	25.90	5.20	5.20	5.20	58.60	0
EAR PLUGS	19.70	4.90	4.90	11.50	59.00	0
REFLECTIVE JACKET	40.00	2.20	4.40	0	51.10	2.20
HAND GLOVES	29.60	3.70	7.40	7.40	51.90	0
SAFETY HARNESS	23.10	10.80	7.70	6.20	52.30	0
SAFETY BOOTS	36.40	2.30	9.10	0	52.30	0
AVERAGE	32.06	4.09	7.75	3.79	52.08	2.20

RESEARCH FINDINGS AND DISCUSSION

All 123 respondents to the survey were male. This was not planned, female construction workers were not encountered while administering the questionnaires. Sixty - Seven percent (67%) of respondents were skilled workers while 33% of respondents were unskilled labourers.

The study identified a list of possible occurring hazards on construction sites from literature. Respondents confirmed that these hazards are real and do occur on their work sites. "Falls from a height" was unanimously agreed as the commonest hazard that occurred on sites. This is in line with the observation that "Falls from height is the most common type of accident in the construction industry (Jeong, 1998; Haslam et al, 2005, BLS 2015).

On the provision of PPE on the site, 62.3% of workers interviewed admitted that their companies provided PPE on the site. Helmets, reflective jackets, safety boots, nose masks, ear plugs and safety harnesses were identified as the commonly procured PPE on the sites; however, workers usually received helmets, reflective jackets and safety boots, while the other PPE were given when it was considered necessary. A surprising 41.5% of these respondents however admitted to not usually using the requisite PPE while they worked.

Several reasons were given by the workers for the non-use of PPE. Notably, 52.8% reported that although PPE were on site, they were not given to them to use. The workers ascribed various reasons for this. In the personal interviews with the workers, they lamented that they were sometimes refused PPEs because they were not permanent staff of the construction companies. In other cases, PPE that had worn out were never replaced by the supervisors. The supervisors on the other hand indicated that most workers handled PPE in a manner that easily destroyed them, and as such, there was no point in replacing PPE that were spoilt.

32.06% of respondents who received PPEs reported various issues of discomfort with their use. Typical among the complaints were headaches and heat stress with the use of helmets and reflective vests, safety boots being too heavy, poor visibility with safety goggles and impaired hearing with ear plugs. Others complained that the nose masks made breathing quite difficult. Similar complaints were made by Nigerian construction workers (Tanko and Anigbobu, 2012). 7.75% of respondents indicated that PPE gets in the way of work, while 4.08% admitted they did not even know how to use the requisite PPE. A further 3.8% declared that some PPE were usually not relevant to their work on site while 2.2% had absolutely no reason for not using PPE.

CONCLUSION

The responses obtained from this preliminary survey are consistent with the findings made by Laryea (2010) to the extent that construction workers are sometimes not given PPE for use on site and some workers do not use given PPE. Although sentiments from respondents in the study cannot be generalised as those of all Ghanaian construction workers due to the sampling approach, it would be worthwhile for construction organisations to take a critical look at safety protection on construction sites. There is an urgent need for construction workers in Ghana to undergo proper induction on PPE use on work sites, to enhance site safety performance.

From this study however, the paramount reason for lack of PPE use by construction workers can be ascribed, to the various discomforts they feel while using them in their line of duty. The findings from the study justify the need for a pragmatic approach in eliminating some, if not all the issues leading to the discomforts associated with construction workers' use of PPE.

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