

Special issue: Connectivity and innovation in construction

Malena I. Havenvid^a, Mårten Hugosson^b and Finn Orstavik^c

^aDepartment of Real Estate and Construction Management, KTH Royal Institute of Technology, Stockholm, Sweden; ^bDepartment of Organization, Leadership, and Management, Inland Norway University of Applied Sciences, Elverum, Norway; ^cDepartment of Business, History, and Social Sciences, University of South-Eastern Norway, Borre, Norway

ARTICLE HISTORY

Received 9 October 2024; Accepted 9 October 2024

Introduction



The vital role of construction in shaping the future of the built environment puts pressure on organizations, both public and private, to reassess ways of organizing operations, business models and resource utilization. Environmental, social, technical, and economic challenges call for a transformation of the construction industry, which in turn demands scholarly inquiry into what change and innovation implies from both an academic and practical viewpoint. Such an inquiry must evaluate prevailing narratives and investigate conditions from new perspectives (Glass et al. 2022). In this call, we direct attention towards earlier research that indicate that some of the industry's most inveterate problems – on the micro, meso, and macro levels – lie in how construction is organized (e.g. Dubois and Gadde 2002; Winch 2003; Cicmil et al. 2006; Bygballe and Swärd 2019).

Four decades ago, both Latham (1994) and Egan (1998) conceded that there were considerable hurdles in the organization of construction, and highlighted the lack of coordination, communication, and research-based development, as key issues. As a result, some advocated tighter integration and pointed to intra- and inter-organizational approaches such as partnering, integrated project delivery and lean construction, and more technologically oriented approaches involving digitalization, for example, building information modelling (BIM) (e.g. Barlow, 2000; Vrijhoef and Koskela 2000; Costa and Tavares 2012; Rowlinson 2017).

In hindsight, it is questionable whether any of these approaches and processes – to evolve the organization of the construction industry – have consistently delivered the desired effects in terms of increased

innovation. As put in the edited volume compiled by researchers in the European Network for Research on Innovation in Construction (ENRIC) – a pre-cursor of this call for papers: '*... the configuration of the industry has made implementation of these approaches challenging, and thus there appears to be a missing link in our understanding of why such attempts are not as effective in this industry as in others*' (Havenvid et al. 2019).

What is common to the calls of Latham, Egan, and ensuing debate, is the aim of reducing industry fragmentation by augmenting interaction among stakeholders, integrate activities and resources, and thereby promote learning, knowledge accumulation, and ultimately, innovation. Much empirically based research in organization studies and history of technology has highlighted interactions as a precondition for innovation (e.g. Rosenberg 1994; van de Ven et al. 1999). However, with some important exceptions, research in construction on learning and innovation has mostly engaged in demonstrating organizational fragmentation and processual discontinuities, such as those following from the temporary nature of projects and the – often short-lived – coalitions of firms created around mega-projects (e.g. Dubois and Gadde 2002; Miozzo and Dewick 2002; Flyvbjerg 2017). As a consequence, less is known about how opportunities to innovate are related to connecting these interactions; in other words, the potential of social and material entities for becoming connected, and the propensity and intensity in a population for connecting. Arguably, there is less awareness of how innovation in construction is inherent in the processes of interactions and, consequently the *connectivity* of organizations, teams, individuals and the activities and resources they engage in. In line with earlier work of

CONTACT Malena I. Havenvid  havenvid@kth.se  Department of Real Estate and Construction Management, KTH Royal Institute of Technology, Teknikringen 10B, 100 44 Stockholm, Sweden

© 2024 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group
This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. The terms on which this article has been published allow the posting of the Accepted Manuscript in a repository by the author(s) or with their consent.

ENRIC (Havenvid et al. 2019; Ostavik et al. 2024), we in this call for papers aim to inspire novel contributions that enable a different and deeper understanding of how innovation in construction is a function of, or pre-conditioned by, *connectivity*.

Aims and scope of the Special Issue: connectivity and innovation

The primary aim of this Special Issue is to inspire and advance research on innovation in construction by proposing connectivity as a way of framing the analysis. We invite both empirical and theoretical papers. Contributions should explore and demonstrate the relevance of understanding the connectivity of innovation in construction.

Through this call for papers, we aim for an exploration of how innovation and connectivity are coupled in construction, both as empirical phenomena and as concepts. In its most basic form, innovation has been defined as novel resource combinations in economic production (Schumpeter 1934) and as that of an 'implemented reality' in terms of a new standard approach within an organisation's thought structure and operational framework (Van de Ven 1986, p. 604). Similarly, construction innovation is expressed as the amalgamation of both existing and new elements into unique combinations in a fundamentally commercial endeavor, implying creativity, collaboration, and actual usage (Winch 1998; Gann and Salter 2000; Miozzo and Dewick 2002). The need for interaction in innovation endeavors in construction has been expressed in various ways, for instance in terms of collaborative approaches among key project stakeholders (Lloyd-Walker et al. 2014; Larsson et al. 2022), in managing material and immaterial interdependencies within and across projects (Bengtson and Håkansson 2008), in handling exploitation and exploration across firm, project and industry levels (Bygballe and Ingemansson 2014), and between actors and technological artefacts (Harty 2005). There are also studies highlighting the importance of interaction between stakeholders and projects in ecosystems (e.g. Whyte 2019), project ecologies (e.g. Hedborg and Karrbom Gustavsson 2020), and networks (e.g. Crespin-Mazet et al. 2015). It appears that various forms of interaction are required for innovation in construction.

Interactions and, in turn, innovation, are intimately related to the possibilities of connecting actors (Håkansson and Snehota 2017). Inspired by Kolb (2008) and contributions by Engwall (2003), Håkansson et al. (2009), and Merton (1968), we suggest

distinguishing between *the state of being connected, the process of connecting, the potential that (social and material) entities have for becoming connected, and the propensity in a population for connecting*. Conceived of in this way, connectivity is relevant on all levels of analysis: micro, meso, and macro. The concept allows consideration of both stability and change, and of how a manifold of factors influence the process of connecting. Analyses of connectivity can highlight how connections may break, transform and new ones arise, and as such explain past and present innovation processes, and potentially envision future developments (Havenvid et al. 2019). Focussing on connectivity, furthermore, can highlight the significance of agency and power, and how innovation can shape as well as be shaped by social and socio-material interactions (Kolb 2008).

We argue that investigating the significance of connectivity is essential for the scholarship of construction management to come to grips with the way construction innovation is organisationally enacted. This approach highlights the highly variable organisational conditions for interaction and the context-dependent nature of the processes of connecting. The contributions of ENRIC in Havenvid et al. (2019) provided early insights into how connectivity can be a useful analytical lens for understanding innovation. Below, we outline three broad thematic areas that are intended to inspire and to guide potential contributors. These suggestions are not, however, set out to exclude other ideas or points of entry.

Relational behavior, communication, and trust

The dynamics of innovation are profoundly influenced by the connectivity of the individual and other social entities of stakeholders relevant for construction, such as clients, users, contractors, subcontractors, architects, technical consultants, regulatory bodies, financiers etc. Efforts to create change hinge on constructive relational behavior, effective communication, and trust. Interactions and exchanges are crucial, e.g. for developing shared situational awareness (Salas et al. 1995) and fostering productive collaborative interactions (Hartmann and Bresnen 2011; Mkandawire et al. 2022; Hartmann 2023).

The conditions for interaction among individuals and groups influence the trajectory of development and innovation. The objectives of innovators are a direct result of their ability to wield power to form and maintain relationships, and to influence the goals and outcomes of collaborative endeavors (e.g. Bijker 1995;

Latour 2005; Hernes 2010; Lu and Guo 2019; Sage et al. 2021). Often creativity is triggered by unexpected events and outcomes and even incidents in construction projects (Winch 1998). For such problem-solving to evolve and become embedded over time, understanding the relational behavior, formal and informal communication, mutual operational adjustments, and coordination is pivotal. In well-functioning projects, such serendipitous interactions serve to increase trust and create opportunities for innovative solutions and as such, is worth while studying in more detail.

The concept of socio-materiality serves to emphasize the entanglement and connectivity of the material and the human in organizational processes. Understanding how technology, materials, and humans interact in sense-making processes may be critical to understand processes of innovation. Norms and values, negotiations, and 'technological frames' all impact the shaping of goals and linkages (Orlikowski and Gash 1994; Jacobsson and Linderoth 2010; Bergek et al. 2015; Troje and Gluch 2020). In the developments of Construction 4.0 and 5.0, a deeper understanding of such issues will become even more important.

Learning across teams, projects, and organizations

Learning processes are a core aspect of innovation and are evidenced to depend on connectivity. Whether occurring within teams, across projects, or organizations, learning processes occur through interactions over time and are context-dependent. Both formal and informal interactions play a crucial role in understanding learning among stakeholders who are often divided by varying institutional logics, professional orientations, or business cultures (Bergek et al. 2008; af Hällström et al. 2021; Bronke 2023). While every construction project possesses unique characteristics, the knowledge gained by one team or project can be highly useful to future teams and projects (e.g. Hartmann and Dorée 2015; Eriksson et al. 2019; Yu et al. 2021).

However, due to their temporary nature, construction projects do not promote project stakeholders to engage in interaction in an organic way. Rather, formal contracts and collaborative models, such as partnering, ECI (early contractor involvement), and alliances are designed to facilitate effective interactions and learning. The structure of contracts and collaborative models, including public-private partnerships (e.g. Demirel et al.

2017; Eriksson et al. 2019; Sherratt et al. 2020), partnering agreements (e.g. Bresnen 2010; Bygballe and Swärd 2019), and alliances (Lloyd-Walker et al. 2014), affects how innovation is carried out in individual projects and the construction sector at large. However, as contracts and agreements will always be imperfect, learning processes largely depend on the participants' willingness and ability to collaborate within the temporary time-frame (Bresnen 1990). The interplay between formal and informal practices, and the consequences for learning and innovation across teams, projects, and organizations over time, is indeed an interesting area of study.

A focus on connectivity also actualizes the question of how different connectivity patterns can enhance learning processes. Can new types of arenas and channels for information sharing, negotiation, etc. improve learning and knowledge development processes? For instance, in the enhancement of information transfer initiatives and actions, concepts of knowledge management related to big data and AI (artificial intelligence) might emerge as analytically useful.

Standardization, institutionalization, and information technology

The relationship between standards and innovation remains underexplored and could be assisted by a connectivity lens. Standards play a pivotal role in shaping the industry, for example towards practices concerning increased sustainability (Barrett et al. 2023), collaboration (Chakkol et al. 2018), and digitalization. Standards inevitably influence connectivity in degree and by defining its quality. Standards can act both as a catalyst and a barrier for innovation (Bengtson and Håkansson 2008). The way standardization affects the industry's ability to tackle sustainability and other grand challenges is a critical area that merits further research through a connectivity lens.

In the construction industry, bilateral relationships and multi-actor coalitions can be unstable and short-lived (Dubois and Gadde 2002; Miozzo and Dewick 2002; Gadde and Dubois 2010). However, at the same time institutionally embedded connectivity patterns can be long-lived and difficult to change. This is due to an institutionalization of work practices, relationships, and technologies that shape 'how things are done' and ultimately decide what can be innovated and how (Bengtson and Håkansson 2008; Orstavik 2014). This represents an interesting duality of fragmentation and connectivity that deserves further exploration.

Information technologies is a form of benchmark that influence connectivity (Kolb et al. 2020). Furthermore, information technology applications are often important for what Harty (2005, 2008) refers to as ‘unbounded innovation’, which influence work practices and power balances. Research has shown that collaboration and networks are crucial for the effective implementation of BIM and other new technologies (Harty and Davies 2013; Lindblad and Vass 2015; Dainty et al. 2017; Vass and Gustavsson 2017). Technologies like AI, generative design, and digital twins too, hold the potential of transforming practices within construction management. On the other hand, information technology is also shown to exclude certain individuals, groups, or firms, such as SMEs (Dainty et al. 2017). Research is needed to highlight how standards, information technology and related services can modify connectivity and innovation, and vice versa.

Conclusion

With this Special Issue, we seek to advance knowledge on construction innovation by highlighting the close link between connectivity and innovation. The themes above are deliberately broad and suggest possible points of departure that draw from various and cross-disciplinary perspectives. As guest editors, we anticipate diverse contributions that mirror different empirical and theoretical interests that can enhance construction management research in surprising and even thought-provoking ways. We believe that an enhanced understanding of how connectivity and innovation are interrelated and how connectivity can be explored, examined, enacted, and managed to foster innovation, is important and relevant for both scholars and practitioners of construction management.

Special Issue submission process timeline

1. Call for Papers published (October 2024)
2. Submission of extended abstracts (January 2025) (*)
3. Abstracts review and decision (February 2025)
4. Full paper submission (September 2025)
5. Publication (June 2026)

(*) Prospective authors are required to submit extended abstracts, which will provide an opportunity for authors to seek feedback from the guest editors and to receive confidence that the paper proposal is within the scope of this call. Abstracts should be no

more than 1000 words in length including references and should clearly state the research rationale and purpose/aim, the research problem or theoretical question being addressed, the research methods, and, if possible, an indication of key findings.

Disclosure statement

No potential conflict of interest was reported by the author(s).

References

- af Hällström, A., et al., 2021. The role of social ties in collaborative project networks: a tale of two construction cases. *Construction management and economics*, 39 (9), 723–738.
- Barlow, J. (2000). Innovation and learning in complex offshore construction projects. *Research Policy*, 29(7–8), 973–989.
- Barrett, Ú., Brooks, T., & McIlwaine, S. (2023). The effectiveness of green building rating systems in reducing embodied carbon. The 39th Annual ARCOM Conference.
- Bengtson, A., and Håkansson, H., 2008. An interactive view of innovations: Adopting a new timber solution in an old concrete context. *The IMP journal*, 2 (3), 19–35.
- Bergek, A., et al., 2015. Technological innovation systems in contexts: Conceptualizing contextual structures and interaction dynamics. *Environmental innovation and societal transitions*, 16, 51–64.
- Bergek, A., Jacobsson, S., and Sanden, B.A., 2008. ‘Legitimation’ and ‘development of positive externalities’: two key processes in the formation phase of technological innovation systems. *Technology analysis & strategic management*, 20 (5), 575–592.
- Bijker, W., 1995. *Of Bicycles, Bakelites and Bulbs. Toward a theory of sociotechnical change*. Cambridge, MA: MIT Press.
- Bresnen, M., 1990. *Organising construction*. London: Routledge.
- Bresnen, M., 2010. Keeping it real? Constituting partnering through boundary objects. *Construction management and economics*, 28 (6), 615–628.
- Bronke, J. (2023). Exploring on-site institutional logics and contradictions: How institutions are reproduced on the construction site. The 39th Annual ARCOM Conference.
- Bygballe, L., and Ingemansson, M., 2014. The logic of innovation in construction. *Industrial marketing management*, 43 (3), 512–524.
- Bygballe, L.E., and Swärd, A., 2019. Collaborative project delivery models and the role of routines in institutionalizing partnering. *Project management journal*, 50 (2), 161–176.
- Chakkol, M., Selviaridis, K., and Finne, M., 2018. The governance of collaboration in complex projects. *International journal of operations & production management*, 38 (4), 997–1019.
- Cicmil, S., et al., 2006. Rethinking project management: researching the actuality of projects. *International journal of project management*, 24 (8), 675–686.
- Costa, A.A., and Tavares, L.V., 2012. Social e-business and the satellite network model: innovative concepts to improve

- collaboration in construction. *Automation in construction*, 22, 387–397.
- Crespin-Mazet, F., Havenvid, M.I., and Linné, Å., 2015. Antecedents of project partnering in the construction industry: the impact of relationship history. *Industrial marketing management*, 50 (October), 4–15.
- Dainty, A., et al., 2017. BIM and the small construction firm: a critical perspective. *Building research & information*, 45 (6), 696–709.
- Demirel, H.Ç., et al., 2017. Flexibility in PPP contracts: dealing with potential change in the pre-contract phase of a construction project. *Construction management and economics*, 35 (4), 196–206.
- Dubois, A., and Gadde, L.-E., 2002. The construction industry as a loosely coupled system: implications for productivity and innovation. *Construction management and economics*, 20 (7), 621–631.
- Egan, J., 1998. *Rethinking construction*. The report of the Construction Task Force to the Deputy Prime Minister, John Prescott, on the scope for improving the quality and efficiency of UK construction.
- Engwall, M., 2003. No project is an island: linking projects to history and context. *Research policy*, 32 (5), 789–808.
- Eriksson, P.E., et al., 2019. Collaborative procurement strategies for infrastructure projects: a multiple-case study. *Proceedings of the institution of civil engineers – management, procurement and law*, 172 (5), 197–205.
- Flyvbjerg, B., 2017. *The Oxford handbook of megaproject management*. New York, NY: Oxford University Press.
- Gadde, L.-E., and Dubois, A., 2010. Partnering in the construction industry: problems and opportunities. *Journal of purchasing and supply management*, 16 (4), 254–263.
- Gann, D.M., and Salter, A.J., 2000. Innovation in project-based, service-enhanced firms: the construction of complex products and systems. *Research policy*, 29, 955–972.
- Glass, J., Bygballe, L.E., and Hall, D., 2022. Transforming construction: the multi-scale challenges of changing and innovating in construction. *Construction Management and Economics*, 40, 855–864.
- Håkansson, H., et al., 2009. *Business in networks*. Hoboken, NJ: John Wiley & Sons Ltd.
- Håkansson, H., and Snehota, I., 2017. Interactivity in business networks. In: H. Håkansson and I. Snehota, eds. *No business is an Island*. Bingley, UK: Emerald Publishing Limited, 275–287.
- Hartmann, A., and Bresnen, M., 2011. The emergence of partnering in construction practice: an activity theory perspective. *The engineering project organization journal*, 1, 41–52.
- Hartmann, A., and Dorée, A., 2015. Learning between projects: more than sending messages in bottles. *International journal of project management*, 33 (2), 341–351.
- Hartmann, A. (2023). *Learning between projects: An accomplishment of social-material practices in projects*. The 39th Annual ARCOM Conference.
- Harty, C., 2005. Innovation in construction: a sociology of technology approach. *Building research & information*, 33 (6), 512–522.
- Harty, C., 2008. Implementing innovation in construction: contexts, relative boundedness and actor-network theory. *Construction management and economics*, 26 (10), 1029–1041.
- Harty, C., and Davies, R., 2013. Implementing ‘Site BIM’: a case study of ICT innovation on a large hospital project. *Automation in construction*, 30, 15–24.
- Havenvid, M.I., Linné, Å., Bygballe, L.E., and Harty, C., eds., 2019. *The connectivity of innovation in the construction industry*. Abingdon: Routledge.
- Hedborg, S., and Karrbom Gustavsson, T., 2020. Developing a neighbourhood: exploring construction projects from a project ecology perspective. *Construction management and economics*, 38 (10), 964–976.
- Hernes, T., 2010. Actor-Network Theory, Callon’s scallops and process-based organization studies. In: T. Hernes and S. Maitlis, eds. *Process, sensemaking and organizing*. Oxford: Oxford University Press, 161–184.
- Jacobsson, M., and Linderoth, H.C., 2010. The influence of contextual elements, actors’ frames of reference, and technology on the adoption and use of ICT in construction projects: a Swedish case study. *Construction management and economics*, 28 (1), 13–23.
- Kolb, D.G., 2008. Exploring the metaphor of connectivity: attributes, dimensions and duality. *Organization studies*, 29 (1), 127–144.
- Kolb, D.G., et al., 2020. Connectivity in and around organizations: waves, tensions and trade-offs. *Organization studies*, 41 (12), 1589–1599.
- Larsson, J., Eriksson, P. E., Lingegård, S., & Järvenpää, A. T. 2022. Innovation outcomes and processes in infrastructure projects – a comparative study of Design-Build and Design-Build-Maintenance contracts. *Construction Management and Economics*, 40(2), 142–156.
- Latham, M., 1994. *Constructing the team*. London: HMSO.
- Latour, B., 2005. *Reassembling the social. An introduction to actor-network theory*. Oxford: Oxford University Press.
- Lindblad, H., and Vass, S., 2015. BIM implementation and organisational change: a case study of a large Swedish public client. *Procedia Economics and Finance*, 21, 178–184.
- Lloyd-Walker, B.M., Mills, A.J., and Walker, D.H., 2014. Enabling construction innovation: the role of a no-blame culture as a collaboration behavioral driver in project alliances. *Construction management and economics*, 32 (3), 229–245.
- Lu, W., and Guo, W., 2019. The effect of task conflict on relationship quality: the mediating role of relational behavior. *Negotiation and conflict management research*, 12 (4), 297–321.
- Merton, R. K., 1968. *Social theory and social structure. 1968 enlarged edition*. New York: The Free Press.
- Miozzo, M., and Dewick, P., 2002. Building competitive advantage: innovation and corporate governance in European construction. *Research policy*, 31 (6), 989–1008.
- Mkandawire, K., Shabnam, K., Mbugua, L., and Connaughton, J. (2022). Managing interfaces between offsite and onsite construction. The 38th Annual ARCOM conference.
- Orlikowski, W.J., and Gash, D.C., 1994. Technological frames: making sense of information technology in organizations. *ACM transactions on information systems (TOIS)*, 12 (2), 174–207.
- Orstavik, F., 2014. Innovation as re-institutionalization: a case study of technological change in housebuilding in Norway. *Construction management and economics*, 32 (9), 857–873.

- Ostavik, F., Havensvid, M. I. and Hugosson, M. 2024. The transformative power of connectivity in construction innovation. The 40th Annual ARCOM conference.
- Rosenberg, N., 1994. *Exploring the black box – technology, economics, and history*. Cambridge, UK: Cambridge University Press.
- Rowlinson, S., 2017. Building information modelling, integrated project delivery and all that. *Construction innovation*, 17 (1), 45–49.
- Sage, D., et al., 2021. Towards a new theory of construction innovation: a socio-material analysis of classification work. *Construction management and economics*, 39 (8), 637–651.
- Salas, E., et al., 1995. Situation awareness in team performance: implications for measurement and training. *Human factors*, 37 (1), 123–136.
- Schumpeter, J. A., 1934. *The theory of economic development: an inquiry into profits, capital, credit, interest, and the business cycle*. Cambridge, MA: Harvard University Press.
- Sherratt, F., Sherratt, S., and Ivory, C., 2020. Challenging complacency in construction management research: the case of PPPs. *Construction management and economics*, 38 (12), 1086–1100.
- Troje, D., and Gluch, P., 2020. Populating the social realm: new roles arising from social procurement. *Construction management and economics*, 38 (1), 55–70.
- Van de Ven, A., et al., 1999. *The innovation journey*. Oxford: Oxford University Press.
- Van de Ven, A.H., 1986. Central problems in the management of innovation. *Management science*, 32 (5), 590–607.
- Vass, S., and Gustavsson, T.K., 2017. Challenges when implementing BIM for industry change. *Construction management and economics*, 35 (10), 597–610.
- Vrijhoef, R., and Koskela, L., 2000. The four roles of supply chain management in construction. *European journal of purchasing & supply management*, 6 (3–4), 169–178.
- Whyte, J., 2019. How digital information transforms project delivery models. *Project management journal*, 50 (2), 177–194.
- Winch, G., 1998. Zephyrs of creative destruction: understanding the management of innovation in construction. *Building research & information*, 26 (4), 268–279.
- Winch, G., 2003. How innovative is construction? Comparing aggregated data on construction innovation and other sectors – a case of apple and pears. *Construction management and economics*, 21 (6), 651–654.
- Yu, Y., et al., 2021. Towards circular economy through industrial symbiosis in the Dutch construction industry: a case of recycled concrete aggregates. *Journal of cleaner production*, 293, 126083.