

EXAMINING CONSTRUCTION CONTRACTORS' INNOVATION THROUGH THE LENS OF EXPLORATION AND EXPLOITATION

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This study investigates innovation deployment in construction contractor organisations through the lens of exploration and exploitation-learning approaches. Radical vs incremental classification of innovation has been linked with explorative and exploitative learning. Exploration is explained by radical innovation, which is the implementation of innovation in the organisational context. In contrast, exploitation is explained by i) incremental innovation, which is the utilisation of innovation and ii) continuous development of organisational activities. The learning theory demonstrates that organisations need to maintain a balance (ambidexterity) between these two learning approaches for their short-term and long-term survival. Following this argument, a research framework is presented to illustrate how contractor organisations exercise exploration and exploitation (as well as innovation) at project, project portfolio and organisational levels. The framework is based on the theoretical and empirical findings of prior studies which were published on highly ranked journals and conferences. A preliminary interview series with industry experts was carried out to validate the framework and shortlist potential contractor organisations as the case studies. Findings from the preliminary assessment reveal that contractors are way forward in implementing innovation and willing to share their knowledge on various newer innovation approaches. However, the client-driven nature of construction industry delays innovation of contractors, specially at project level. This is an ongoing research. As the future research direction, multiple case studies are yet to be done with the purpose of attaining holistic insights on recent innovative approaches of large-scale contractors in the Hong Kong construction industry.

Keywords: contractor organisations, exploration, exploitation, innovation

INTRODUCTION

Research in construction innovation has a history of more than thirty years, prompting debates over innovativeness in the construction industry, i.e. (Tatum, 1986). The industry has been mostly recognised for its lack of innovativeness (Blayse and Manley, 2004). The project-based nature of the industry has been highlighted as a limiting factor in terms of innovation, as project discontinuance and one-off outputs are widespread in the industry (Dubois and Gadde, 2002). In contrast, the change of current measures of innovation to a contemporary appraising method is emphasised (Bygballe and Ingemansson, 2014). Hence, this paper attempts to investigate innovation in the construction industry, adopting a contemporary perspective while

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considering its project-based and discontinuous nature, focusing specifically on construction contractor organisations.

Innovation generally connotes the implementation and development of breakthrough ideas (Van de Ven, 1986). Researchers tend to classify innovation based on the nature of output, impact of output and nature of process. In this study, innovation is defined considering the nature of output in the organisational context - as the implementation of a new product, process, system, strategy, policy or service in an organisation (Damanpour and Evan, 1984; Slaughter, 1998). Therefore, traditional measurements such as profit, number of patents, and R&D allocation might not be able to capture the innovation in organisational procedures, contracts arrangements and system integration methods (Bygballe and Ingemansson, 2014; Winch, 2003). Organisations should be able to assess the intangible benefits caused by innovation such as knowledge update, enhanced reputation and increased social networks (Slaughter, 1998).

More recently, the explore-exploit dichotomy has been adopted to explain innovation in organisational management research. This concept was initially introduced considering the nature of the process (March 1991). Exploration includes activities such as “search, variation, risk-taking, experimentation, play, flexibility, discovery, and innovation” (March 1991, p.71); and exploitation includes activities such as “refinement, choice, production, efficiency, selection, implementation and execution” (March 1991, p. 71). In a broader view, exploration suggests a search for new opportunities. On the contrary, exploitation involves improving the existing certainties. More recent studies tend to explain exploration and exploitation considering their nature of outcomes (Eriksson *et al.*, 2017). For instance, ‘radical innovation’ has been used to explain exploration, whereas ‘incremental innovation’ and ‘continuous development’ are adopted to explain exploitation (Eriksson and Szentes, 2014). The outcomes of exploration are less certain compared to exploitation, as exploitation utilises the existing knowledge and learns from feedback. Therefore, its consequences are quicker, more certain and more accurate.

The application of exploration-exploitation paradox into project-based settings has rarely been discussed in construction management research, particularly in the contractor perspective. Even though innovation in construction is mostly client-driven, contractors’ involvement is inevitable (Slaughter, 1993). Early involvement of contractors caused by collaborative and digitalised procurement approaches has enhanced contractors’ capabilities of fostering innovation in the industry (Bresnen *et al.*, 2003; Eriksson, 2013). Having selected qualitative research approach and large-scale contractors as the potential cases, this study attempts at answering the research question: how is innovation deployed in construction contractor organisations?

Theory: Exploration, Exploitation and Organisational Ambidexterity

Initially, the mutual exclusiveness of exploration and exploitation (also called explorative learning and exploitative learning) was accepted as a practical issue (March 1991). Subsequently, a contradictory view emerged highlighting organisations’ ability to exercise and manage both exploration and exploitation simultaneously. The concept of ambidexterity was then introduced as the ability to balance exploration and exploitation. Three forms of ambidexterity have been identified in the previous literature, which are structural, temporal/sequential and contextual (Eriksson, 2013; Turner *et al.*, 2014). Structural ambidexterity is managing exploration and exploitation by allocating different organisational units. On the

contrary, undertaking these two learning approaches in different time periods is called temporal or sequential ambidexterity (Benner and Tushman, 2003; Tushman and O'Reilly, 1996). Contextual ambidexterity is integrating exploration and exploitation at individual, team, department or project level in an organisation. In organisations where contextual ambidexterity is adopted, trusting skills and capacities of employees to perform both exploration and exploitation is prioritised (Andriopoulos and Lewis, 2009). This form of ambidexterity is recommended for Project-based organisations (PBO), particularly to manage exploration and exploitation at project level (Gibson and Birkinshaw, 2004).

Construction Industry Context

As a project-based industry which forms temporary project settings to deliver one-off outputs, the whole process and result is uncertain and riskier. This heterogeneous nature discourages construction organisations' interest to adopt contemporary and innovative methods; in other words, exploration is hindered. However, recent arguments claim innovation in construction is often underestimated, and there is a necessity of acknowledging hidden innovation in the industry. The concept of exploration and exploitation has been applied in recent construction management research as a different perspective to explain innovation in the organisational context (Bygballe and Ingemansson, 2014). Eriksson (2013) investigated how construction project-based organisations (PBOs) manage exploration and exploitation at different organisational levels. Findings of research such as the impact of co-creation practices on exploration and exploitation in construction projects (Eriksson *et al.*, 2017) and forms of ambidexterity in projects (Eriksson, 2013) demonstrate the antecedents of exploration and exploitation as well as risks involved with explore-exploit paradox in construction process. Large and complex projects have been recognised for their ability to handle both exploration and exploitation. When a problem occurs such as time or cost overrun, project actors have sufficient resources to solve such problems by adopting innovative solutions (exploration). In contrast, exploitation has been recommended for small-scale and simple projects which have limited resources. Existing knowledge can be used to solve problems and secure project success (Eriksson, 2013; Turner *et al.*, 2014). The necessity of collaborative procurement approaches as a strong integrating mechanism to mitigate risks involved with explore-exploit paradox has been emphasised as well (Bresnen *et al.*, 2003; Eriksson, 2013). Following these arguments and adopting Eriksson and Szentes' (2014) explanations for exploration and exploitation, the following research framework is presented (see figure 1).

THE RESEARCH FRAMEWORK

As shown in the following research framework (see figure 1), organisational and project levels are shown in a hypothetical contractor organisation. At both levels, exploration and exploitation are exercised in different forms of ambidexterity (i.e. contextual ambidexterity at project level and structural ambidexterity at organisational level). Following Bygballe and Ingemansson's (2014) analytical model, the knowledge transfer between two levels is shown by arrows, i.e. project-to-organisation, organisation-to-project and within projects. Knowledge (obtained from learning) transitions among different levels is important to enhance organisations' capability to innovate (Bygballe and Ingemansson, 2014; Eriksson, 2013; Liu and Chan, 2016). Knowledge can be declarative (facts) and procedural (skills and routines) (Argote, 2012; Gherardi, 1999). Even though this framework does not

indicate the project portfolio level and their knowledge transitions to prevent confusions, the contextual ambidexterity is still applicable for project portfolio level.

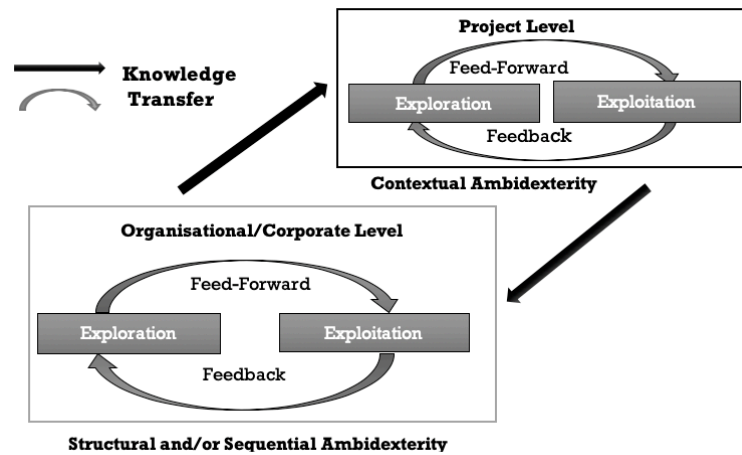


Figure 1: The research framework to explain innovation at different levels in construction contractor organisations

Constructs explanation

Having considered the nature of output of each learning approach, exploration of a hypothetical contractor organisation is explained by their radical innovation which is the implementation of innovation to address the emerging needs of the organisation (Eriksson *et al.*, 2017). Exploitation, on the other hand, is explained by the combination of incremental innovation and continuous development. Incremental innovation is defined as the utilisation of innovation, which is the known innovative solutions that have worked and are intended to use in future (without changes or with minor changes). Continuous development is explained as the fine-tuning of current work, which is not necessarily innovation (Eriksson and Szentes, 2014). As the framework suggests, both radical and incremental innovation can be observed simultaneously at project and project portfolio levels. Radical innovation at these levels can be spontaneous, and it can be considered as a problem-solving approach as well. In contrast, radical innovation at organisational level is well-planned and managed. The organisational strategies and policies for innovation can be clearly observed through radical and incremental innovation deployment at organisational level. Knowledge transfer through effective communication among different levels has also been addressed in this framework. For instance, the knowledge associated with exploration at project level turns into exploitation at organisational level.

The Hong Kong construction industry

This study is carried out in the context of Hong Kong construction industry. The industry is a leading construction industry in Southeast Asia as well as in the world and known for massive infrastructure and high-rise buildings (Rowlinson *et al.*, 2010). The industry's contribution to the economy, in particular the Gross Domestic Product (GDP), has increased from 4.0% in 2013 to 5.1% in 2017 (Census and Statistics Department The HKSAR, 2017) which makes the industry a crucial component in enhancing the economy and living standards in Hong Kong (Awale and Rowlinson, 2015; Chan *et al.*, 2013). Despite being an industry leader in the Southeast region, certain issues hinder Hong Kong's sustainable development. Health and safety awareness, labour shortage, ageing workforce, construction waste and landfill issues,

and the lack of collaborative nature of the industry are yet to be solved (Construction Industry Council, 2015; GovHK, 2015). The culture and structure of Hong Kong's construction industry comprise of both British and Chinese characteristics; hence, the industry itself is a mixture of the western and eastern world. Rigid and hierarchical administration in Hong Kong has been inherited by British sovereignty for Hundred and fifty-six years. This created a dearth of collaborative features in the whole construction process. Besides, the government (or clients) plays a major role in decision making (Rowlinson *et al.*, 2010).

Nevertheless, the industry is now undergoing one of its peak periods. Several strategies have been implemented to meet the demand and mitigate relevant industry issues such as recent interests in fostering innovation, collaborative procurement approaches, construction safety-the vision of 'zero accident' and digitalisation of process. The contribution of large-scale contractors in implementing these approaches is significant.

METHODOLOGICAL IMPLICATIONS

As the research methodology, the interpretivist stance and qualitative approach accompanying three research methods were considered to answer the research question. First, a preliminary interview series with industry practitioners who are experienced in implementing innovation in the Hong Kong construction industry was carried out. The objectives of this interview series are; i) validate the research framework and its theoretical arguments through studying the innovation deployment of contractor organisations, ii) examine the current status of Hong Kong construction industry regarding its innovation deployment and iii) shortlist the potential contractor organisations to conduct case studies. Through the literature review of this paper, the developed research framework with its theoretical arguments is discussed. The following section discusses the findings of preliminary interview series.

This is an ongoing research. Second and major research method, multiple case studies are yet to be done. Large-scale² contractor organisations in Hong Kong who are known for implementing innovation will be selected as the case studies. As the third and final research method, an expert interview series will be carried out to validate the research findings.

FINDINGS

Preliminary interview series

Five face-to-face semi-structured interviews were carried out in English with industry practitioners who represent contractor organisations, an engineering consultant organisation and a government construction organisation in the industry. All the interviewees were selected based on their experience, knowledge and contribution to the innovation in the Hong Kong construction industry as well as their managerial position in respective organisations. All the individuals have at least a degree or diploma in civil engineering, town planning or construction management with relevant professional qualifications, and two of them have obtained postgraduate qualifications as well. In addition to the five formal one-hour in-depth interviews, findings of two

² Contractors who are under the Category C for Buildings works, Port works, Road and Drainage, Site Formation and Waterworks. The categorisation is given by Development of Bureau for Public works in Hong Kong (Development Bureau The HKSAR, 2019).

informal interviews were incorporated to obtain the final output. The demographic information of participants is summarised in the following table 1.

Table 1: The demographic information of interviewees

Code	Position	Experience	Organisation
PI01	Director	15 years	Contractor Organisation
PI02	Head of Innovation	12 years	Contractor Organisation
PI03	General Manager- Innovation	07 years	Contractor Organisation
PI04	Manager	14 years	A government organisation for promoting innovation in the HK construction industry
PI05	Temporary Works Systems Manager	43 years	Private Engineering Consultant

All the interviews were audio-recorded, and transcripts were produced. The Thematic analysis technique was adopted incorporating NVIVO 12 software to identify three main themes (along with the objectives of preliminary interview series) which are i) innovation deployment of Hong Kong construction industry ii) case study selection and iii) innovation deployment of contractor organisations. The coding structure was then created adding sub-themes. The themes and sub-themes were selected based on the interview guideline as well. The following table 2 indicates a brief version of the coding structure.

Innovation in the Hong Kong construction industry (Theme 01)

All the interviewees have had a positive feeling regarding the innovativeness of Hong Kong construction industry and yet pointed out the necessity of having a digital transformation in the industry, an innovative procurement model for procuring projects which facilitates contractors' early involvement, collaboration and innovation. However, PI05 was not satisfied with the current situation and justified his stance as “small scale innovation are just add-ons. They are not the revolution of the entire industry. It might enhance productivity or make it slightly more comfortable. However, it is not a revolutionary change or radical innovation”. He further elaborated that the HK industry needs a client-driven digitalised system change, which is more efficient. PI03 pointed out that involvement of government can be observed through fund allocation, decision making, and establishing an organisation to promote innovation among construction stakeholders.

While agreeing to this statement, others stressed out the necessity of modifying current regulations to speed up the design approval process. Everyone mentioned that involvement of contractor organisations (large-scale main contractors) in fostering innovation is satisfactory. However, only a few numbers of contractor organisations are engaged or have a capacity to foster innovation due to the issues such as lack of resources and knowledge, lack of incentives, lower profit-margin, time-consuming design approval processes, lack of risk sharing procurement strategies and client-driven nature of the industry.

Selection of Case studies (Theme 02)

All the interviewees work or have worked in contractor organisations. Therefore, their judgement based on size, age, recent innovation practices, awards received, reputation and accessibility to obtain data were considered for shortlisting two potential case studies from nine large-scale contractor organisations who belong to Category C (see the footnote 1).

Table 2: The brief version of coding structure

Main Theme	Sub-theme(s)		
1.0 Innovation deployment of HK construction industry	1.1 Innovativeness-as an industry		
	1.1.1 Satisfactory, yet certain actions should be taken		
	1.1.1.1 Digital transformation		
	1.1.1.2 An innovative procurement model		
	1.1.1.3 Contractor’s early involvement		
	1.1.2 Not satisfactory-revolutionary change is a must		
	1.2 Involvement of government		
	1.2.1 Satisfactory		
	1.2.1.1 having an organisation to promote innovation		
	1.2.1.2 fund allocation		
	1.2.1.3 decision making		
	1.2.2 Satisfactory, yet certain actions should be taken		
	1.2.2.1 modification of design approval process		
2.0 Case study selection	1.3 Involvement of contractor organisations		
	1.2.1 Satisfactory		
	1.2.1.1 Yet, a few numbers of contractors are engaged		
	1.2.1.2 Incentives for contractors are not sufficient		
	2.1 Name (i.e. Contractor A)		
	2.1.1 Size		
	2.1.2 Age		
	2.1.3 Recent innovation		
	2.1.4 Awards received		
	2.1.5 Other		
	3.0 Innovation deployment of contractor organisations (validation of research framework)	3.1 Name (i.e. Contractor A)	
		3.1.1 Exploration-radical innovation	} at organisational, project portfolio levels
		3.1.2 Exploitation-incremental innovation	
3.1.3 Exploitation-continuous development			
3.1.4 Exploitation-continuous development			
3.1.4.1 organisation-to-project			
3.1.4.2 Project-to-organisation			
3.1.4.3 Between projects (project portfolio)			
3.1.4.4 within projects (project level)			

Innovation in Contractor Organisations (Theme 03)

Contractor organisations were examined in terms of their organisational structure, culture, innovation deployment strategies at organisational, project and project portfolio levels. A separate central division or a team has been established to manage innovation within organisations. However, project leaders are responsible for the innovation of each project. Innovation team acts as the facilitator and progress reviewer. In this regard, integration and collaboration among different business units and different organisational levels (corporate/organisational, project, project portfolio) can be observed. Also, digital communication tools are highly relied upon for transferring relevant knowledge. The involvement of top management in taking initiatives and making strategic decisions in fostering innovation within the organisations and with external parties are clearly visible. In addition, organisation management has provided several platforms to encourage employees (at any level) to

present innovative ideas. Organisations tend to update their knowledge by hiring experts from different countries, observing foreign construction projects and their strategies as well as collaborating with research and academic institutions.

Validation of Framework and Discussion

Having analysed the preliminary interview findings, the research framework is validated. A separate innovation division or a team at organisational/corporate level in contractor organisations shows the structural ambidexterity. The involvement of both project actors and innovation team at head office (corporate/organisational level) in exercising exploration and exploitation at project level shows the contextual ambidexterity. In addition, the use of digital communication tools, monthly meetings and frequent weekly visits made by the head office personnel indicate strong knowledge transfer mechanisms at different levels. Examples for radical innovation (exploration), incremental innovation and continuous development (exploitation) and knowledge transfer have been received from interviewees. Therefore, this study is expected to continue with deep investigations on explorative and exploitative learning within case studies. The findings of case studies on recent innovation in Hong Kong are expected to make valid and reliable suggestions to enhance the innovativeness, efficiency and productivity of the industry. The findings are also expected to contribute to theoretical discourses on exploration and exploitation.

CONCLUSIONS

This study aims at investigating how construction contractor organisations deploy innovation at organisational, project and project portfolio levels through the lens of the learning theory - exploration and exploitation. Radical vs incremental classification of innovation has been linked with this learning theory to explain innovation. The developed research framework suggests both exploration and exploitation can be simultaneously exercised at project and project portfolio levels. Structural separation is required at organisational level.

This study unfolds that contractor organisations in Hong Kong have a positive attitude towards implementing innovation. Despite their active participation, incentives to foster innovation have rarely been provided. Lower profit margin, absence of innovative procurement approach which facilitates collaboration and early involvement of contractor in construction process, and lesser contractual provisions for sharing risks have been highlighted as the innovation-hindering factors for contractors. Innovation in the Hong Kong construction industry is client driven. As the largest client, the role of government to foster innovation is inevitable. The involvement of government is satisfactory, however the necessity of modifying the approval processes has been stressed out. The overall result shows that the Hong Kong construction industry, specially the contractor organisations have realised the necessity of a more innovative and digitalised construction industry. As the next step of this study, these results will be incorporated to conduct case studies to disclose how contractors implement innovation, tangible and intangible benefits, risks and challenges, their strategies to overcome issues, and future intentions to enhance the overall construction process.

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