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EMERGING TECHNOLOGIES AND THEIR LEVERAGE ON FRAGMENTATION IN THE CONSTRUCTION INDUSTRY

Bolanle Ireti Noruwa, noruwab@uni.coventry.ac.uk
PhD Candidate, School of Energy, Construction and Environment, Faculty of Engineering, Environment & Computing, Coventry University, United Kingdom.

ABSTRACT

Construction industry in the UK contributes 6.1% of GDP with output worth more than £108 Billion per annum. The global worth of the industry currently stands at $10 Trillion and is expected to rise to $13 Trillion by 2025. Conversely, the industry is troubled and dogged by challenges for decades, such as fragmentation and contractual issues. But emerging technologies are driving radical change in the industry. Synthesizing these new technologies with best practices which are not necessarily digital but underpin interdependence are vital even in the current nature of disintegration in the construction markets. However, studies on best practice and technologies are conducted separately. The paper aims to investigate anticipated 'disruptive' impact of emerging technologies in the UK construction industry. Research method adopted is documentary analysis of archive data and information obtained from completed and ongoing construction projects in the UK which implemented diverse emerging technologies in automation, digitalisation and new innovative materials. The result was validated through a formal process of member-checking. Findings reveal that some emerging technologies in the UK construction industry is still at infancy stage but statistics indicate more industry uptake and acceptance. Emerging technologies may be considered as indisputable strategy for overcoming fragmentation; however, synthesizing technologies with best practices in the industry will putatively lead to the attainment of integration and collaboration not yet achieved in the industry.

Key Words: Construction Industry, emerging technologies, fragmentation

INTRODUCTION

Construction industry is popularly known as 'low tech' industry and an industry resistance to change (Gu and London 2010). Emerging technologies are recognized as main source of improvement and competitive advantage to construction firms and as critical solution to shortage of skilled labour, safety for construction workers and boost to productivity (Ho and Liu 2003). Collaboration is important to construction design and management process to project whole lifecycle due to construction projects been large and complex in nature. True models of the physical work are needed by most team players to perform their roles efficiently. Fragmentation among team will result to distorted final physical product. Investment in new technologies in construction may not be yielding full benefits anticipated in the meanwhile but their leverage on the challenges of the industry is becoming evident. It is yet unclear how to perfectly ascertain profitability of technology investment on a construction project (Love et al., 2013), but it is becoming evident that some emerging technologies in construction are leveraging on some of the challenges of the industry. Impact such as improved project performance, reduced design changes and better multidisciplinary information sharing platform (Francom and Asmar 2015). But synthesizing best practices with adoption of technology is important for optimisation as technology alone cannot increase or decrease performance and productivity (Kang et al., 2013).

EMERGING TECHNOLOGIES IN CONSTRUCTION

As construction projects become more complex and sophisticated, automation and digitalisation of construction processes will help to integrate design and construction, enhance productivity and reduce cost. Details of emerging technologies and their application in construction is given in Table 1.

Table 1: Details of Emerging Technology in Construction

Technology	Details	Application in construction
Digital	Data, software, mobile devices and the cloud	For communication, reporting, collaboration and enhancement of decision-making.
	Big data, Artificial Intelligence (AI) and advance analytics	Analyses big data for decision making. Provide users real time information for maintenance and decision making.
	Project management and digital collaboration	Enhance collaboration, assign tasks and assists contracto with administration and compliance with regulations and safety on site. Allows for transparency and enable data-mining in large scale.
	Building Information Modelling (BIM)	Produce 3D modelling of design, allows virtual twinning the structures, speed decision making process, manage change and enable workers to run various scenarios. 3D, 5D, 6D and 7D BIM is for visualization, construction sequencing, estimation, facility management and materials/objects tracking respectively.
	Sensors and Internet of Things (IoT)	IoT allow connectivity of many intelligent devices with tl ability to communicate with one another and humans. Sensors measure operational variables such as identificati of individuals, tools, materials, speed, telecommunication devices, infra-red, body temperature, fatigue and environmental conditions.
	Spatial measurement, tracking and geolocation	Helps information to be transmitted wirelessly from workers, tools, materials, vehicles and equipment to a designated server for display, process and analyses. Geolocation technologies are used for personnel safety, s security, fraud detection, and project management.
	Augmented Reality (AR) and Virtual Reality (VR)	Enable construction clients to interact and understand the unbuilt structure. Allow a live direct and indirect view of real-world and the physical environment.
Automation	3D scanning, printing and mapping	3D scanning creates 3D images of unbuilt structure which can be visualized in other devices. 3D laser scanning is us to obtain the correct measurements of a building. 3D mapping enables construction progress monitoring throug crane mounted camera.
	Robotics	Used for construction tasks that are repetitive and predictable such as bricklaying, demolition, tiling, and concrete dispensing.
	Drones	Visual inspection of tricky sites and high-risk areas, maintenance inspections, materials inventory, aerial surv transportation of items across sites and inspection for construction progress report
	Autonomous vehicles	Replace the use of manual labour on site and speed up project completion time.
	Construction wearables	They are used or worn by site workers to monitor their health status, emotional stress and fatigue.

FRAGMENTATION IN THE UK CONSTRUCTION INDUSTRY

Fragmented nature of construction industry has been viewed as critical barrier to innovative transformation that limit knowledge production and root cause of persistent low productivity (Latham 1994). Fragmentation is a well-known challenge plaguing construction industry. Construction projects are complex and hard to manage, for easy constructability, it is common to divide works into packages for different trades and subcontractor to undertake. This division become problematic for interdependence of stakeholders especially when these parties are from several diverse countries of the world. Also, when procurement strategy adopted on a project separate design and construction as in the case of design-bid-build, fragmentation of team players may be apparent challenge. The ripple effect of fragmentation is lack of transparency and ineffective communication among project team that further increase project complexity, time and cost. However, Ghaffarianhoseini et al., (2017) argued that 'Rapid advancement of technology continues to leverage change and innovation in the construction industry'.

METHODOLOGY

Data for this study were collected from completed and ongoing construction projects in the UK which implemented diverse emerging technologies in automation, digitalisation and new innovative materials. Project selection was limited to construction project completed in the last five years or ongoing projects. Implementation of BIM was used as prerequisite for project selection. A focus group meeting with six experts from construction industry was convened to explore whether the information gathered resonance with participants' current experience and knowledge of project management. Bowen (2009) defined document analysis as 'a systematic procedure for reviewing both printed and electronic materials'. It is a staple qualitative research method that requires data to be interpreted and examined like other analytical methods to draw meaning, gain understanding and develop empirical knowledge (Corbin and Strauss 2008). Focus group meeting took place on Monday, 19th of March 2018 at John Laing Building, faculty of engineering, Coventry University between 15.00 and 16.30. Findings from the meeting were recorded and transcribed. Signed informed consent were obtained from all participant. The population sample consists six experts with over 20 years of industrial experience in the construction industry.

FINDINGS AND DISCUSSIONS

Technologies adopted on most projects analysed enabled clients and contractors to collaborate and experience real time governance which assisted in achieving projects' desirable outcomes. It is apparent that more awareness, training and development activities are needed among Small and Medium Enterprises (SMEs) in construction industry to achieve holistic collaboration anticipated for when new technologies are implemented. Findings further revealed new wave of collaboration among industry practitioners, construction firms and higher institution of education. It appears adoption strategies for new technologies in procuring construction projects in higher institution analysed includes deliberate intention to bridging knowledge gap and disseminate first hand training and information to students. Lack of 'innovation mindset' among senior top executives of construction firms who may not consider new technologies as priority in their decision making was observed. This standpoint may affect diffusion of emerging technologies and prolong fragmentation in construction industry. In comparison with BIM, implementation of other technologies like drones, 3D printing and robotics appeared to be at infancy state despite the importance of these new technologies in construction. CII (2017) identified and extensively explained seventeen proven best practices through extensive industry broad use and validation in construction management. Some of

these practices includes Front End Planning, Project risk assessment, quality management, team building, partnering, change management, constructability among others.

CONCLUSIONS

From archive documents analysis of completed and ongoing projects that implement new technologies in construction such as BIM, various software, online digital collaboration platform and others, these emerging technologies has led to effective collaboration among construction team compare to tradition approach. In addition, there is deduction in design conflicts or clashes, more efficient workflows, easier construction planning and the reduction of construction cost and time. Nevertheless, synthesizing technologies with best practices mentioned in this study will putatively lead to the attainment of integration and collaboration not yet achieved in the industry. Construction industry is very unique, complex in nature and produces mostly one of a kind product. Views from expert in the construction believed is not all about the technologies alone but about the attitude of the users and stakeholders in position of decision making. Combination of best practice and technologies will give companies a distinct competitive and will putatively lead to the attainment of integration and collaboration not yet achieved in the industry. Array of emerging technologies in construction offer project team better way of communication and collaboration more than ever before.

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