Mitigating the Risks of Offsite Manufacturing through the Application of BIM

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ABSTRACT

The Iranian construction industry is facing several problems including low productivity and immense housing scarcity. It is generally believed that industrialisation and offsite manufacturing can increase the productivity of the Iranian housing industry. Yet, one of the major issues of the Iranian construction industry is defective management during design and construction processes which has considerably increased the risks of offsite construction in Iran. BIM could theoretically address these issues thanks to its potential advantages such as improved efficiency, productivity, and quality. As one of the key stakeholders, architects have a major role in the current situation of the Iranian construction industry. A questionnaire survey was conducted in architectural SMEs to study the normal practices of architects during design and construction processes on site. Frequent design changes and defective communication between stakeholders were identified as the major issues. The results reveal that BIM in general and integrated design in particular could effectively address the aforementioned issues mitigating the risks of offsite manufacturing in Iran.

Keywords: Building Information Modelling (BIM), Construction Project Management, Housing, Integrated Design, Iran, Offsite Manufacturing

1. INTRODUCTION

The inability of the Iranian construction industry to satisfy the country’s massive housing demand has transformed the housing demand and supply into one of the major challenges facing the government. Iran needs over a million residential units to be constructed annually to overcome its housing demands in a period of 16 years (BHRC, 2009). Around 95% of all construction projects in Iran are related to housing (SCI, 2013). It has been argued that industrialisation and offsite manufacturing can improve the current situation by increasing the housing outputs in Iran (Hashemi & Hadjri, 2014; Darjizi, 2010; BHRC, 2009; Hashemi, 2009). The Iranian construction industry however suffers from various shortcomings which increase the risks of offsite manufacturing in Iran.

One of the major issues which may increase the risks of offsite construction is the lack of communication, coordination, and planning during design and construction stages. Construction has historically been the outcome of
several independent ideas of clients, designers, engineers, contractors and other stakeholders who have had their different inputs in different stages of the project. This situation makes the industrialisation of construction industry much more difficult than other industries (McEvoy, 2014). Collaboration and effective communication between different stakeholders during design and construction are therefore critical for industrialisation as well as for the efficient and successful delivery of construction projects.

Accurate planning and design is required when it comes to offsite fabrication (Eastman et al., 2008). Decisions should be made and fixed in early stages of the project (CABE, 2004) as late changes may be too costly (Hashemi & Hadjri, 2014; NAO, 2005). Designers and manufacturers should also work closely together in order to decide on an appropriate construction system (Burwood & Jess 2005; CABE, 2004; Pasquire & Connolly, 2003). Building Information Modelling (BIM) can potentially improve the coordination of different stakeholders by improving the communications processes throughout the design and delivery of construction projects (NHBC, 2013).

This study intends to study the current situation of the Iranian construction industry in terms of design and construction management processes in architectural practices and evaluate the potential of BIM to mitigate the risks of offsite construction in order to improve the productivity of the Iranian housing industry. To this end, a questionnaire was designed and distributed in architectural SMEs to study the normal practices of Iranian architects during design and construction processes on site. The levels of collaboration/communication of architects with different stakeholders as well as the extent of design changes in various stages of projects were studied.

1.1. Building Information Modelling (BIM)

Building Information Modelling/Management is a relatively new subject in Iran. In broad terms, BIM is referred to as digital/computer representation of various construction functions and processes which facilitate the exchange of information between different stakeholders (Hardin, 2009; Sebastian et al., 2009) during design, construction and operation of the building (Figure 1).

BIM is more than simple 2D/3D CAD drawings. BIM can be defined as the parametric design of a building which allows the building to be virtually designed and constructed by the project team enhancing the collaboration between different bodies involved in the construction processes (NHBC, 2013; Hardin, 2009). The virtual models can potentially increase the efficiency by reducing the errors before the construction on site (NHBC, 2013). BIM also facilitates the integration of information generated by various stakeholders during the lifecycle of the building (HM Government, 2012) from initial design through to demolition. BIM as a process can facilitate the efficient management and distribution/exchange of information throughout the design, construction and operation of buildings reducing the time and costs while improving the quality (NHBC, 2013). According to NIBS (2007), BIM employs various technologies in order to maximise computing capacities to automate those tasks which are traditionally risky and labour intensive.

The potential cost savings of BIM application during the design stage is estimated to reach to 40%; however, the measured benefits shows savings between 8-18% of design fees (BIS, 2011). Yet, many people involved in the housing industry are either unaware of BIM or do not see as to how BIM can enhance their day-to-day works and responsibilities (NHBC, 2013). Many countries are noticing the potential advantages of BIM implementation in the construction industry. The UK government, for example, has mandated the application of BIM in all its projects from 2016 in an attempt to increase awareness and encourage the use of BIM in the construction industry (NHBC, 2013; NBS, 2012; Cabinet Office, 2011). Two major functions of BIM during the design and construction processes are documen-
Sum of the Parts: Leveraging BIM to Achieve Effective Delivery of Mass Customised Housing


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