An Investigation Into ‘Lean-BIM’ Synergies in the UK Construction Industry

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ABSTRACT

This article highlights the advantages of Lean Construction (‘Lean’) and Building Information Modelling (‘BIM’) that have received much attention. Individually, each promises transformative and beneficial effects on the construction process, prompting researchers to consider the possibility of synergies between the two. An early example is the hypothetical ‘Lean-BIM Interaction Matrix’ of Rafael Sacks and his collaborators. In this, Lean principles are set against BIM functionality and synergies predicted. Early tests of the proposals were through retrospective case studies. Further promising results have been demonstrated in construction projects in the USA. This suggests that similar results might be possible elsewhere, prompting the present UK study. The methodological approach is case-study based on projects where the contractor purports to be using (i) Lean principles, (ii) BIM, and (iii) both. Evidence will be collected through a variety of means (including interviews, documents, and observation). The research is currently at a stage where data has been collected from the first few case-study projects.

KEYWORDS

Building Information Management, Lean Construction, Productivity, Work flow

INTRODUCTION

For several decades the management of the United Kingdom’s Architectural, Engineering and Construction (AEC) industry has been criticised for high levels of waste, delays, and budget over-runs. Indeed, little seems to have changed between the reports that highlighted these problems more than two decades ago (these are conveniently summarised and discussed in Murray & Langford, 2008) and their more recent counterparts (for example, Wolstenholme, 2010 and CLC, 2016). Two of the most recent and notable efforts from within industry to resolve these problems are examined here. The first involves the use of a conceptual approach to project/construction management, borrowed from the manufacturing sector, and commonly called ‘Lean Construction’ (hereinafter, simply ‘Lean’). The other is the potentially transformative advance in information technology known as ‘Building Information Modelling’ or sometimes ‘Building Information Management’ (hereinafter, simply ‘BIM’). We first briefly examine the two developments independently, charting their development and seeking evidence of their effect on construction project outcomes. Next, building on a seminal article by Sacks et al. (2010) and work that followed it, we lay the foundations for testing the hypothesis that BIM and Lean are no longer independent of each other, and that maximum benefits can be realized by simultaneous implementation of both. However, we recognise that BIM and Lean are multifaceted concepts, each requiring careful analysis before any conclusions are drawn about their synergies.

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LEAN CONSTRUCTION: ASPECTS AND BENEFITS

Lean Production is a management-based approach to project delivery whose origin can be traced back to the developments of Toyota Automobile in Japan after World War Two. Toyota created the Toyota Production System (TPS), a system of ‘lean’ manufacturing which focuses on eliminating waste, creating value upstream, and eliminating non-value-adding steps while making value-adding steps flow, and pursuing perfection through continuous improvement. Researchers in the general use of lean production include Schonberger (1996), Liker (2003), Womack and Jones (2003). From the 1990s an interest started in the application of Lean Production to the construction process. Some of the very many investigations into the application of Lean to Construction include Koskela (1992, 1997), Alarcón (1997), Ballard and Howell (1997), Howell and Ballard (1998), Howell (1999), Green, (1999), Koskela et al. (2002), Bertelsen (2004), Salem et al. (2006), Johansen and Walter (2007), Sacks et al. (2009), Alarcón (2011), Sarhan and Fox (2013), Marodin and Saurin (2013), Bamford et al. (2015), and Vrijhoef (2016). This interest in Lean Construction has produced an international Lean Construction Institute (https://www.leanconstruction.org/) with its associated academic journal (https://www.leanconstruction.org/about-us/publications/lean-construction-journal/) and the International Group for Lean Construction (IGLC) with its annual conferences (from 1993) and publications (http://iglc.net/). Green and May (2005) point out that Lean Construction is “a multifaceted concept that defies universal definition” and suggest that construction academics “tend to see lean construction to be ‘inspired’ from lean production, rather than being a direct derivative.” According to Eriksson (2010) “various aspects of lean construction can be grouped into six core elements”. Eriksson names these as: waste reduction, process focus in production planning and control, end customer focus, continuous improvement, cooperative relationships, and a systems perspective. It is within the second of these aspects that what is probably the best-known manifestation of lean in construction, Ballard’s (2000) Last Planner® tool, belongs. The Last Planner® System utilises many of the lean principles listed in Sacks et al. (2010) and which are listed later. Green and May suggest that this tool has achieved a greater degree of industrial penetration than any other, and that “in some circles, ‘last planner’ and ‘lean construction’ are synonymous” as it can be “more easily ‘bolted-on’ to existing practices” (Green & May, 2005: 503). Despite the readiness to adopt lean practices (particularly Last Planner®) evidence of the results is not easy to find. This is undoubtedly due to the difficulty in isolating the effects of any intervention from those of other factors that might affect the success of a project. Perhaps the most extensive report of evidence for the benefits of Lean Construction implementation has been published by Alarcón et al. (2011) and this includes reduction of variability, manpower productivity, construction cost and schedule reductions.

BIM AND THE CONSTRUCTION PROJECT

The term BIM can be applied both to a process “for creating and managing information on a construction project across the project lifecycle” (NBS, 2017) or a product (i.e. a Building Information Model) that contains digital information about the constructed asset. It is the former application that is of interest in the current context. A construction project generates a huge amount of information added from the design, construction, through to the operational life of the built asset. This information comes in the form of both geometric and non-geometric data which needs to be managed efficiently in order to exploit it to the full. The BIM Roadmap produced for the Building Services Research and Information Association (BSRIA) states that “BIM processes and practices allow information and data to be produced in a digital format to facilitate greater collaboration between the various parties involved in the provision and operation of an asset.” (Sands, 2015, p.2). The concept in the mid-1980s and the first use of ‘Building Information Model’ appears to have been in a paper by van Nederveen and Tolman (1992). Interest grew in the application of BIM technologies to construction industry problems and in the UK, this culminated in its adoption by UK Government as part of its Construction
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