



The proliferation of ICT and digital technology systems and their influence on the dynamic capabilities of construction firms

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Abstract

Information and Communication Technologies (ICT) are changing the way we work and play. Such changes are evident in the design, construction and operation of large construction projects. Programs such as building information modelling (BIM) and various other innovative digital technologies and engineering systems are changing the way we materialise all aspects of construction projects. This proliferation of ICT and digital technologies facilitated the adoption of various innovative approaches in processes and various ICT systems throughout a project life-cycle and across its supply chain. This has great implication on construction firms providing a new challenge by reconfiguring their resources to rise to the new challenges of large construction projects. ICT is changing three different aspects of large scale projects. As a tool during the build, i.e. BIM, for the ongoing building functionality i.e. BMS and lastly benefiting occupants experience. The integration of these three ICT aspects are forcing firms to rethink their current ICT management systems. Through a case study in a large scale healthcare project, this paper uses a case study to investigate the application of various innovative ICT and digital technology systems on the dynamic capabilities of a construction firm and across the supply chain of a project. The case study presented is the New Royal Adelaide Hospital (nRAH) in South Australia. This is a joint venture project under a Public Private Partnership agreement to design and construct AUS\$1.85b hospital. The case study showed that various challenging examples of functional complexity exists that required innovative process management approaches by the construction firm to withstand the test and trial of such a complex project, to successful completion. This has further contributed to the elevation of the dynamic capabilities of the construction firm as well as to its overall reputational assets and branding, nationally as well as internationally.

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1. Introduction

The construction industry is one of the main contributors to the national economy with an annual growth of approximately 10% in Gross Domestic Product. However, the industry is widely being criticised for its lack of innovation with results in low productivity. The proliferation of Information and Communication Technologies (ICT) is influencing today's modern society in all aspects of life. Despite the wider benefits of the adoption of ICT in all industries, specifically construction, it often comes with high costs and disruption to typical management models. The wide uptake of building information modelling and the application of various ICT systems are seen as a way to enhance the productivity of the construction industry. The application of such disruptive technologies has great implications on current construction management models.

Various business models in construction focused on the competitive advantage of firms [1] and resource-based view [2]. The need for convergence of concepts such as knowledge management, organisation learning and reflective practice are stipulated as means for improving the performance of construction firms [3]. More recently the concept of dynamic capabilities has found great prominence in construction to enable firms to respond to a changing environment [4]. It is argued that the uptake of ICT is providing construction firms with great challenges in the way they operate. Construction firms, due to their nature of being project based business, has a distinguished set of competitive advantages. The notion of dynamic capabilities can help firms to reconfigure their resources while acquiring new ones to respond adequately to the change within their environment brought by the development of ICT and the demand of construction of large projects such as hospitals.

It is argued that the construction industry is experiencing a change the industry is being expected to completely adapt their current ways to allow for the management and design of large complex ICT systems within large scale projects. This need for adaptation for large scale complex projects has been evident within the new Royal Adelaide Hospital (nRAH) in South Australia. These large scale complex projects can also be referred to as intelligent buildings. Intelligent buildings are buildings 'that integrate technology and processes to create a facility that is safer, more comfortable and productive for its occupants, and more operationally efficient for its owners [5]. Advanced technology combined with improved processes for design, construction and operations provide a superior indoor environment that improves occupant comfort and productivity while reducing energy consumption and operations staffing.' [5,6] Projects are characterized as intelligent buildings mainly due to size, complexity and the relationship between technology systems. These systems are typically undertaken by separate organisations; coming together specifically for the project. This collaboration brings difficulty due to such different work practices and cultures [5].

With regard to the nRAH project, the various adaptations of Public Private Partnerships (PPP) for the procurement of large scale projects has changed the center point, timeframe and working arrangements of many construction contracts and firms. This is mostly due to the change from standard 'product delivery to through-life service support' [7] and with this comes a shift in risk. The complexity and uniqueness of large scale projects like the nRAH raise challenges within management systems in relation to communication, testing of ICT systems and the implications for the life-cycle and ongoing building management. Due to the time length of these projects changes of personal and management structure can be a major problem. In the case of the nRAH the addition of working within the health sector (stakeholder) and with a large amount of involvement from the South Australian Government had a profound impact on established practices and management structures.

Consequently, building a new hospital is a complex undertaking and delivering the project with little to no failure rate, delivering within budget, on time and with the required features and function can be extremely difficult. This is possibly due to the number of unknowns, the incorporation of new complex technologies and the increase in risk of delivering a large scale complex project.

This paper investigates the impact of the adoption of various ICT systems in large and complex projects such as the nRAH using a case study method incorporating various interviews and project document analysis.

2. What is Information Communication Technology (ICT)

Information Communication Technology commonly known as ICT is becoming less of an option and more of a necessity. This is especially evident in the construction industry. ICT is defined as an umbrella term that includes any communication device or application, encompassing: radio, television, cellular phones, computer and network

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