Chapter 17
The Post-Occupancy Digital Twin:
A Quantitative Report on Data Standardisation and Dynamic Building Performance Evaluation

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ABSTRACT

Through the application of building information modelling (BIM), the construction industry can now develop digital representations of physical assets. By combining BIM with digital technologies such as the internet of things (IoT), an opportunity is created to link real-time data to digital representations, resulting in the creation of digital twins (DT). A major aspect in the creation of DT involves the ongoing relationship between physical and digital versions of assets through interlinked sensors, generating an opportunity to analyse the performance of the asset and its occupants. The aim of this report was to further understand the effects of implementing these technologies, resulting in the digitalisation of the construction industry. A literature review was undertaken, along with a focused interview questionnaire and an online survey. Results showed that although there was an awareness of the importance of BIM and digital technology within the construction industry, the number of projects implementing these technologies and procedures were low.

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INTRODUCTION

The construction industry is currently in a transition phase. Findings from the McKinsey Report (Manyika et al., 2015) identified the global construction industry as the second least digitalised and technologically innovated of all industries. Both reports also discussed that research and development (R&D) investment in construction was less than 1% of revenue, when compared to other sectors, including the automotive and aerospace sectors, with a 3.5–4.5% investment (Manyika et al., 2015). This suggests that the construction and building sector has not adopted digital technologies in line with other sectors and is still heavily reliant on traditional processes and deliverables (Wong, Ge, & He, 2018).

Findings from the Hackitt Report (Hackitt, 2018) show the failings of the construction industry in relation to providing digital information required for efficient running and maintenance of assets. It was found that data obtained throughout the Design and Build (D&B) phase was not provided in digital formats which resulted in delays sourcing the relevant data for each stage of the build. The report emphasized the importance of digitising construction projects through Building Information Modelling (BIM), along with the standardisation of digital data distributed through a Common Data Environment (CDE), resulting in easily accessible digital information throughout the project (Hackitt, 2018).

Digitalisation of the Construction Industry

Level 2 BIM involves the creation of digital project information, following industry standard guidelines. Combining BIM with digital technologies such as the Internet of Things (IoT) results in the creation of Digital Twins (DT). DT provide an opportunity for dynamic data analysis throughout the capital delivery phase into the operation and maintenance (O&M) phase.

Digital Twin Technology

To implement and improve digitalisation of the construction industry, efficient management of data generated from BIM is critical. Implementation of digital technologies such as Digital Twin (DT) and Internet of Things (IoT) throughout all phases of a building's lifecycle provide opportunities to ensure that buildings are performing as intended, with early identification of any anomalies.

The Digital Framework Task Group (DFTG) refers to DT as *"a realistic digital representation of assets, processes or systems in the built or natural environment"*. This may refer to a real-time updated collection of data, models, algorithms or analysis (Bolton et al., 2018). A DT is a digital representation of a physical element or product which mimics its real-world behaviour.

To create a DT, three main criteria are required:

1. Physical element.
2. Virtual representation.
3. Interconnecting graphical and non-graphical data and documentation to link the physical and virtual (Zheng, Lin, Chen, & Xu, 2018).

A further nine aspects of DT-enabled service innovation in the manufacturing field were identified including: