Chapter 23
BIM Bin:
Waste Management Through BIM and Digital Twin

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ABSTRACT

A groundswell of opinion exist about the present and future use of smart cities and digital twin technologies and processes and, despite increasing use of information modelling, artificial intelligence, and internet of things, many challenges remain in designing and implement integrated smart systems in large scale contexts. Often, the big picture is shadowed by fragmented processes, and there is a disconnect between the problem and the solution. This chapter aims to address this inverted approach, based on a solution looking for a problem by focusing on the problems of developing integrated solutions for smart cities based on digital twins. The narrative in this chapter is informed by a research project exploring the digitalisation of facilities management processes in Bath, UK. The conclusion is that the development of digital twins goes far beyond linking digital models to sensors.

DOI: 10.4018/978-1-6684-7548-5.ch023

INTRODUCTION

We want to improve our cities, but neglect critical issues that can lead to improvement. We crave efficiency and yet ignore the many areas that enable increased efficiency. We crave health but fail to deliver an integrated care service focused on a preventive approach. We spend a lifetime inside buildings that are poorly designed, built and maintained. Buildings are often too hot, too cold, too damp, with high levels of embedded CO2. They contribute to cities' poor sustainable performance. Cities can be overly crowded, incredibly unsafe, excessively polluted and fail to provide the right conditions for citizens to thrive. We also pay the price for not looking after our cities adequately, for not reacting quickly enough, and for not preventing problems before they occur. The response to COVID19 and the blast in Beirut are contemporary examples of these failures. Although the desired alignment between the different areas involved in the design, construction, operation and maintenance of cities has been continuously evolving as a reflection of enhanced technology, there is still much to do.

Early research, such as Hollands (2008), shows that from time to time, it is essential to revisit the troublesome multifaceted smart cities concept. Albino et al., (2015) and Caragliu et al., (2011) share this view. For both, fast developments in technology expands our understanding of smart cities and what can be done to make them smarter. Here, smart cities are defined as "an urban (data) ecosystem that emphasises the use of digital technology, shared knowledge and cohesive processes to underpin citizen benefits in sectors such as mobility, public safety, health and productivity." Essential to this definition is the concept of a digital twin. This way, we frame smart cities within a digital twin-based solution to address the key challenges that we face now and will face in the future. These include a growing population, increased traffic and pollution, increased waste generation, reduced access to homes and public spaces, and resources such as water and energy. This approach also offers a solution to tackle global warming as a result of uncontrolled carbon emissions in the context of tighter city budgets and ageing infrastructure. The problem and the solution are complex, for realising smart cities requires great efforts and a multidisciplinary integrated approach.

Here the smart cities subject is explored through the lens of the AEC sector. Much like everything else, AEC is undergoing a digital transformation. Technologies that heretofore were restricted to digital solutions are permeating the pre and post construction building industry. Companies can now create building data ecosystem grids to capture and analyse data trails from building users and determine how to enhance building performance. These building data ecosystem grids seed the development of smart cities when connected to one another. In other words, on the one hand BIM becomes a platform for data integration; on the other hand it becomes data ecosystems built around service analytics platforms that tie the ecosystems together, thus creating a digital twin. Such a transformation has been fostered by several disruptive Information and Communication Technologies (ICT), such as Building Information Modelling (BIM), Artificial Intelligence (AI), the Internet of Things (IoT) and most recently the Internet of Behaviour (IoB). However, the transformation is still slow, and while a unified platform does not exist, we will continue working with parts of a bigger reality, that is 'dizygotic' digital twins.

The part of the reality studied in this chapter is related to the use and operation phase of building assets. Previous studies in this area have focused on technologies for data collection, storage and sharing (Fialho et al., 2019; Ye et al., 2018). As explained later in this chapter, these studies promote digital ways to improve building efficiency and their point of departure tends to be the implementation of technology. This is often achieved through BIM-supported simulation tools that predict the performance of newly designed buildings. However, considerably less attention has been given to service performance. It is