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A Review of Digital Twins to Reduce Emission in the Construction Industry

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Abstract : The carbon emission problem of the traditional construction industry has long been a pressing issue. With the growing emphasis on environmental protection and advancement of science and technology, the organic integration of digital technology and emission reduction has gradually become a mainstream solution. Among various sophisticated digital technologies, digital twins, which involve creating virtual replicas of physical systems or objects, have gained enormous attention in recent years as tools to improve productivity, optimize management and reduce carbon emissions. However, the relatively high implementation costs including finances, time, and manpower associated with digital twins have limited their widespread adoption. As a result, most of the current applications are primarily concentrated within a few industries. In addition, the creation of digital twins relies on a large amount of data and requires designers to possess exceptional skills in information collection, organization, and analysis. Unfortunately, these capabilities are often lacking in the traditional construction industry. Furthermore, as a relatively new concept, digital twins have different expressions and usage methods across different industries. This lack of standardized practices poses a challenge in creating a high-quality digital twin framework for construction. This paper firstly reviews the current academic studies and industrial practices focused on reducing greenhouse gas emissions in the construction industry using digital twins. Additionally, it identifies the challenges that may be encountered during the design and implementation of a digital twin framework specific to this industry and proposes potential directions for future research. This study shows that digital twins possess substantial potential and significance in enhancing the working environment within the traditional construction industry, particularly in their ability to support decision-making processes. It proves that digital twins can improve the work efficiency and energy utilization of related machinery while helping this industry save energy and reduce emissions. This work will help scholars in this field to better understand the relationship between digital twins and energy conservation and emission reduction, and it also serves as a conceptual reference for practitioners to implement related technologies.

Keywords : digital twins, emission reduction, construction industry, energy saving, life cycle, sustainability
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