

Digital Twins: Towards an Overarching Framework for the Built Environment

Authors : Astrid Bagireanu, Julio Bros-Williamson, Mila Duncheva, John Currie

Abstract : Digital Twins (DTs) have entered the built environment from more established industries like aviation and manufacturing, although there has never been a common goal for utilising DTs at scale. Defined as the cyber-physical integration of data between an asset and its virtual counterpart, DT has been identified in literature from an operational standpoint - in addition to monitoring the performance of a built asset. However, this has never been translated into how DTs should be implemented into a project and what responsibilities each project stakeholder holds in the realisation of a DT. What is needed is an approach to translate these requirements into actionable DT dimensions. This paper presents a foundation for an overarching framework specific to the built environment. For the purposes of this research, the UK widely used the Royal Institute of British Architects (RIBA) Plan of Work from 2020 is used as a basis for itemising project stages. The RIBA Plan of Work consists of eight stages designed to inform on the definition, briefing, design, coordination, construction, handover, and use of a built asset. Similar project stages are utilised in other countries; therefore, the recommendations from the interviews presented in this paper are applicable internationally. Simultaneously, there is not a single mainstream software resource that leverages DT abilities. This ambiguity meets an unparalleled ambition from governments and industries worldwide to achieve a national grid of interconnected DTs. For the construction industry to access these benefits, it necessitates a defined starting point. This research aims to provide a comprehensive understanding of the potential applications and ramifications of DT in the context of the built environment. This paper is an integral part of a larger research aimed at developing a conceptual framework for the Architecture, Engineering, and Construction (AEC) sector following a conventional project timeline. Therefore, this paper plays a pivotal role in providing practical insights and a tangible foundation for developing a stage-by-stage approach to assimilate the potential of DT within the built environment. First, the research focuses on a review of relevant literature, albeit acknowledging the inherent constraint of limited sources available. Secondly, a qualitative study compiling the views of 14 DT experts is presented, concluding with an inductive analysis of the interview findings - ultimately highlighting the barriers and strengths of DT in the context of framework development. As parallel developments aim to progress net-zero-centred design and improve project efficiencies across the built environment, the limited resources available to support DTs should be leveraged to propel the industry to reach its digitalisation era, in which AEC stakeholders have a fundamental role in understanding this, from the earliest stages of a project.

Keywords : digital twins, decision-making, design, net-zero, built environment

Conference Title : ICAADST 2023 : International Conference on Advanced Architectural Designing and Structural Technologies

Conference Location : Tokyo, Japan

Conference Dates : December 04-05, 2023