

Framework for facility management of bridge structures using digital twins

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Abstract

The maturity of Digital Twin (DT) models has evolved in the aerospace and manufacturing industries; however, the construction industry still lags behind. DT technology can be applied to achieve smart management through the entire life cycle of structures. Particularly for bridge structures, which play an essential role in any transportation system and can have high maintenance demands throughout their long life spans. In this study, a literature review on DTs was performed, from the origins of the concept until current best practice focused on bridges. Especially concerning structural analysis and facility management, few studies that employ DT for bridges were encountered. The main challenges identified are related to treatment of the large amount of data involved in the process, mostly gathered from different platforms. Finally, a framework for smart facility management of bridges using DTs was proposed to tackle potential solutions.

Keywords: digital twins; bridges; BIM; BrIM; facility management; review.

1 Introduction

Bridge structures have significantly long theoretical life spans. Most bridges on the national road networks in the European Union have been built during the last 50 years, although some are much older [1]. Deterioration and failures have increased in the already aging bridges due to consistent growth in automobile traffic, environmental exposure and internal defects. In addition, the loads to which many bridge structures are being subjected are far greater than those envisaged when they were designed [1]. Therefore, these types of structures are often taken as objects of study, especially considering the fundamental role

they play in the transportation system of any country.

Existing bridges are inspected with some regularity to ensure that their operation remains safe and efficient. However, the inspection process is challenging, as it might face time, access, financial and safety issues. As a result, many maintenance strategies focused on bridges have been developed over the years, together with new and automated technologies for bridge inspection.

Transport agencies usually manage bridge inventory, inspection and health condition data through bridge management systems (BMS). The objective of a BMS is to preserve the asset value of the infrastructure by optimizing costs over the