Developing a Maturity Model of Digital Twin Application for Infrastructure Asset Management

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Abstract : Faced with unprecedented challenges including aging assets, lack of maintenance budget, overtaxed and inefficient usage, and outcry for better service quality from the society, today's infrastructure systems has become the main focus of many metropolises to pursue sustainable urban development and improve resilience. Digital twin, being one of the most innovative enabling technologies nowadays, may open up new ways for tackling various infrastructure asset management (IAM) problems. Digital twin application for IAM, as its name indicated, represents an evolving digital model of intended infrastructure that possesses functions including real-time monitoring; what-if events simulation; and scheduling, maintenance, and management optimization based on technologies like IoT, big data and AI. Up to now, there are already vast quantities of global initiatives of digital twin applications like 'Virtual Singapore' and 'Digital Built Britain'. With digital twin technology permeating the IAM field progressively, it is necessary to consider the maturity of the application and how those institutional or industrial digital twin application processes will evolve in future. In order to deal with the gap of lacking such kind of benchmark, a draft maturity model is developed for digital twin application in the IAM field. Firstly, an overview of current smart cities maturity models is given, based on which the draft Maturity Model of Digital Twin Application for Infrastructure Asset Management (MM-DTIAM) is developed for multi-stakeholders to evaluate and derive informed decision. The process of development follows a systematic approach with four major procedures, namely scoping, designing, populating and testing. Through in-depth literature review, interview and focus group meeting, the key domain areas are populated, defined and iteratively tuned. Finally, the case study of several digital twin projects is conducted for self-verification. The findings of the research reveal that: (i) the developed maturity model outlines five maturing levels leading to an optimised digital twin application from the aspects of strategic intent, data, technology, governance, and stakeholders' engagement; (ii) based on the case study, levels 1 to 3 are already partially implemented in some initiatives while level 4 is on the way; and (iii) more practices are still needed to refine the draft to be mutually exclusive and collectively exhaustive in key domain areas.
Keywords : digital twin, infrastructure asset management, maturity model, smart city
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