Digital Twins in rail and road infrastructure asset management

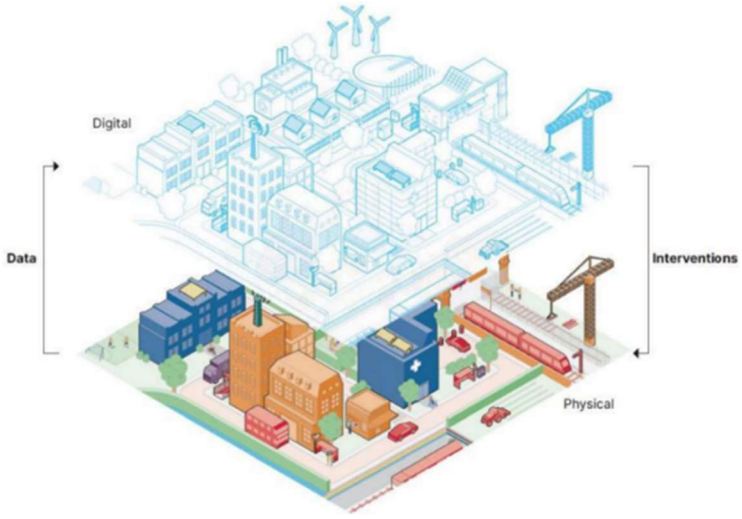
Summary

Transportation infrastructure is responsible for linking society together, ensuring the daily transportation of people and goods. When an interruption occurs, major social and economic losses are frequently incurred (Berdica, 2002). Moreover, these infrastructures play a strategic role in the achievement of the Sustainable Development Goals, namely those regarding innovation, sustainability and resilience of cities and built infrastructures. Rail and road networks, as two of the main physical and linear transportation networks, account for more than 63 % of goods transport and almost 90 % of passenger transport within the EU (EU, 2020). As critical infrastructures to economic, social and environmental development of societies, rail and road networks are also challenging infrastructures to manage, since their assets are usually very dispersed geographically and cover a wide range of expertise areas. Furthermore, the increasing demand, the ageing of these infrastructures, and historical intervention backlogs contribute to the increasingly challenging asset management decisions. Because infrastructure managing organizations do not usually have all the resources needed (or readily available) to cope with these needs, good asset knowledge and asset management practices become key issues to efficiently manage such a diverse infrastructure portfolio, that constantly competes for investment. Asset management, as a coordinated activity of an organization with the goal of realizing value from its assets (ISO 55000, 2014), is data intensive and needs tools and processes to collect and manage asset data, to ultimately improve organizational knowledge and decision making.

The revolution of Industry 4.0 is considered to be a new paradigm of digital, autonomous, and decentralized asset control and is providing new tools and techniques that could help in dealing with such problems, taking a step further towards the vision of smart infrastructures. One of Industry 4.0 emerging approaches is Digital Twin (DT). DT has been attracting increasing research interest and has produced value in several sectors, especially in manufacturing and aerospace industries. However, the rail and road networks domain has still received scant attention. This research work is expected to contribute in this regard, namely by: i) providing a background knowledge review of DTs in rail and road infrastructures; ii) addressing the potential impacts and opportunities derived from its application in the asset lifecycle management of rail and road infrastructures; iii) providing a roadmap for DT application in this kind of organizations. The case studies of a portuguese rail and road infrastructure management body and ongoing innovation projects related to DT are presented to validate the proposed work structure.

Keywords

Digital twin, asset management, rail, road, transport, infrastructure.



The Digital Twin concept (CDBB, 2021).

PhD student
João Pedro Cardoso Vieira

PhD program
Civil Engineering (IST, University of Lisbon)

Supervisor
Nuno Almeida (CERIS, IST, University of Lisbon)

Co-supervisor
João Poças Martins (FEUP, University of Porto)

Period
2019-2024

Funding
Infraestruturas de Portugal, S.A. Scholarship