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DIGITAL TWINS

TRANSFORMING THE WAY WE BUILD ROADS

There's never been a better time for asset owners to adopt digital twins to unlock significant value and provide benefits for themselves, their customers and safeguard their staff in these uncertain times. **James Colclough**, Civil Infrastructure Digital Project Delivery lead at AECOM, outlines key technologies and considerations that every asset owner should take — no matter what the project size.

The UK Government is firmly focused on encouraging asset owners to maximise value from a data-driven approach through the efficient and predictive management of assets.

In July 2018, HM Treasury launched the Centre for Digital Built Britain's National Digital Twin programme to help unlock an additional £7 billion per year of benefits across the UK infrastructure sector [1]. In addition, the international ISO19650 standard for managing information over the whole lifecycle of a built asset has been in place for over a year, extending the reach of the UK Government digital agenda.

Consequently, digital twins are fast becoming a realisation for many road asset owners. Developing on the foundations of BIM delivery, the digital twin is enabling beneficial uses of a connected and rich database of road information that has been developed through all stages of delivery from design to construction and beyond into operation and maintenance (O&M). In addition, the quality and availability of this asset data is also becoming increasingly important.

> THE DIGITAL TWIN IS ENABLING BENEFICIAL USES OF A CONNECTED AND RICH DATABASE OF ROAD INFORMATION THAT HAS BEEN DEVELOPED THROUGH ALL STAGES OF DELIVERY FROM DESIGN TO CONSTRUCTION

Through the delivery of major infrastructure schemes such as Thames Tideway Tunnel, HS2 as well as numerous Highways England schemes, AECOM is continuously realising the benefits of a digital approach which provides better asset information, greater efficiency, higher quality as well as health and safety benefits — all underpinned by effective collaboration.

It is important to note that these processes are no longer confined to megaprojects. We are moving to a transformational phase where the benefits of a digital approach are being realised across a range of schemes, especially projects with complex programmes, collaborative requirements or challenging specific activities.

However, adoption across the roads sector is still inconsistent — there are some valid reasons for this. Here is a breakdown of some of the considerations and benefits of a digital approach, as well as the long-term value of a having a digital asset alongside a physical one.

> A DIGITAL TWIN BY NAME NEEDS TWO VERSIONS – THE PHYSICAL AND DIGITAL.

Developing the twin: common barriers and key first steps

A digital twin by name needs two versions — the physical and digital. The development of new assets, or their refurbishment, provides an excellent opportunity to develop a digital version in the first instance and then go on to build a 'smart' physical asset where performance can be monitored using the digital twin.

However, the application of digital twins across the whole asset estate can be complicated. Existing assets will already have a physical form but often limited accompanying digital data. Many asset owners also feel constrained by the standard and variety of their existing databases. What's more, we also often find that projects develop a design model whose life is extended into the construction phase but that many asset owners are not ready to develop this information into a digital twin at handover. As a result, we often have to simplify this information for use in the O&M stage, rather than enhance it as we would like.

Implementing a wider digital strategy right from the start of a new project or programme is key to addressing these issues. For example, defining information requirements and procuring data from the supply chain that meets these needs is an essential first step. Likewise, a transitional plan is often needed to marry legacy data with new digital twins.

The true value of a digital twin resides within the longer operational phase of a physical asset — although it is worth bearing in mind that the digital twin needs further focus to ensure data can be digitally used within inspection and maintenance systems.

The recent upturn in digital skills will be beneficial in the long-term

We have seen recently the increased adoption of digital solutions to enable social distancing, including digital collaboration tools and increased use of Common Data Environments to keep businesses operational. For civil infrastructure projects, we have turned to drones and other remote sensing methods to remove the necessity of sending our staff to site to survey. The upturn in digital transformation has the potential to benefit the development of digital twins. We also have an opportunity to utilise their data to remotely undertake O&M tasks.

The importance of digital libraries: a lesson from the housing sector

Linear infrastructure projects are starting to adopt the use of modern methods of construction, including modular construction and 3D printed assets where the digital process is fundamental to rethinking these forms of delivery. To some extent, the basis of these methods has been adopted for some time, but now we are seeking to make a step change in delivery. Manufacturing in factories may also provide a safer and controlled environment for workers in the coming months ahead.

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The development of digital libraries and design automation processes drives efficiencies and standardisation of design output. We have identified the importance of developing, prototyping and refining the digital component library explicitly for off-site manufacture, a key lesson from the housing sector and now being applied in our Rail, Power and Roads sectors. This requires clients and the industry to collaborate and form partnerships to challenge traditional methods of design and construction.

The digital library offers us another benefit of embedding reusable asset information. Suddenly the process of developing the digital twin becomes a product of a better process.

Quality of data and the rise of artificial intelligence (AI)

Maximising the use of this new digital data requires thought, as well as planning, around the systems that store and use it. This is often achieved through a series of connected systems that have individual functions, such as document management, finance, asset management and risk management.

There is also a need to place greater focus on the quality of the data, ensuring it is classified and structured. Many of the advanced digital applications, including AI solutions, are reliant on this. Our AI design anomaly detector — called ALi — has been developed to improve the quality of designs and provide efficiency gains. Its ability to 'learn' what an error looks like when assessing design models is enhanced when components are classified. It can better determine relationships between them and provide significant value to the assurance process.

> "WE ARE ALSO SEEING THE EXPONENTIAL INCREASE IN INTEREST AROUND AI SOLUTIONS FOR AUTOMATED ASSET DEFECT RECOGNITION. —

For asset management, consideration of how the data will be used for inspection and maintenance, as well as planning purposes (such as predictive maintenance) can be a very valuable exercise. The role of smart assets and their connectivity with the digital twin is being explored to provide real-time data on performance and reduce manual inspection programmes. This provides a more cost effective, sustainable, remote and customer-friendly solution.

We are also seeing the exponential increase in interest around AI solutions for automated asset defect recognition. The industry is recognising the potential efficiencies of being able to use video and 360 degree imagery to capture asset data, including condition. AECOM is using reality capture solutions and working with our clients to realise the benefits of using our AI tool. This method also enables more frequent inspections and potentially reduced network issues.

The need for digital leadership

In order to fully realise the benefits of digital twins, strong leadership is needed to standardise the fundamentals of sound information management, development and delivery for all projects. Further innovation of digital processes and solutions can then be considered based on the needs of the project and the ability to see a Return on Investment.

Realising these benefits also requires digital leadership from all asset owners, including an increased focus on the workforce and their skills (e.g. Industry 4.0). Many now have a better understanding of what information is required from their supply chain and should seek to support upskilling and awareness initiatives.

In short, asset owners are in an excellent position to grasp this golden opportunity to adopt a digital approach which will, in turn, provide long-term benefits for themselves, their staff and customers — especially now that we look to create a new working norm. The future is definitely digital. WL

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