Digital twins will transform the sustainability of digital infrastructure

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Sylvain Loizeau, Sabre Konidaris, Ida Hugander

The implementation of digital twins has helped certain digital infrastructure operators to cut their carbon emissions by over 30%. Digital twins are virtual models that mirror infrastructure components, assets, systems and processes. By providing operators with superior access to more accurate data, these models enhance strategic decisions, leading to minimised energy usage and maximised efficiency in the deployment of network equipment.

Digital twins are extremely useful for identifying sources of inefficiency in large and complex systems. In telecoms networks, for instance, marginal efficiency improvements can drive significant financial and sustainability uplift. Creating digital twins allows operators to harness advanced artificial intelligence (AI) and cloud computing to improve operational performance (and reduce operating expenses) associated with digital infrastructure assets.

The economic efficiency enabled by digital twins is creating a growth market

Advantages for network operators include fewer site visits (improving efficiency of maintenance crews and reducing the vehicle fleet), preventative maintenance (extending the life of network hardware and physical structures, and reducing network downtime), and optimised equipment set-up (allowing more efficient use of network equipment and greater energy efficiency). Enhanced asset lifecycle management (including asset design and construction) helps these capital-intensive companies to allocate their capital expenditure to more cost-effective and sustainable projects.

Recognising these benefits, digital-twin start-ups backed by venture capital firms secured more funding in the first five months of 2023 than over the preceding 5 years. Furthermore, cross-industry reports suggest that 63% of executives who understand the benefits of digital twins intend to incorporate the technology into their operations by 2029. Accordingly, the digital-twin market is forecast to grow at a double-digit compound annual growth rate (CAGR) over the next decade, representing a surge in operationally transformative opportunities for digital infrastructure operators.

Sustainability plays a key role in the digital-twin investment decision

According to a 2021 survey of 800 organisations, 34% of organisations across diverse sectors have implemented digital twins to predict energy consumption and emissions, with 57% considering sustainability improvements as a key investment driver. Digital twins present a sizable opportunity for digital infrastructure operators striving to achieve increasingly ambitious sustainability targets.

Data-centre operators, for example, can use digital twins to replicate the facility's lifecycle and improve energy efficiency, which is a significant financial and environmental cost driver and thus a critical focus for regulators

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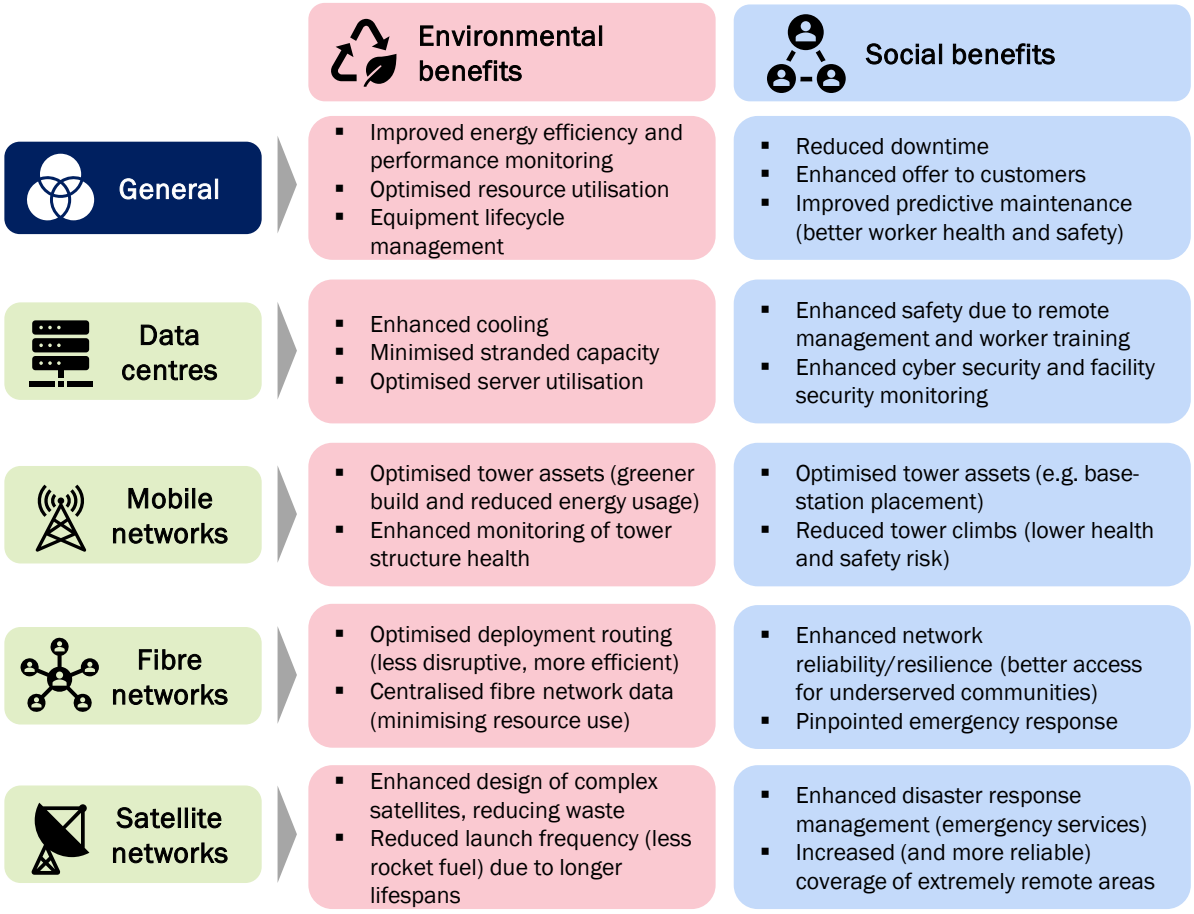
and financiers with increasingly strict environmental, social and governance (ESG) requirements (as discussed in a previous article). Digital twins can be used to identify and deal with stranded capacity (such as unnecessary or ineffective cooling equipment) and underutilised servers, and to predict energy usage patterns and propose modifications based on impact assessments.

A valuable example can be seen in Thésée Datacenter, a French IT service company that uses digital twins to monitor airflow, heat transfer, cooling, power and capacity metrics. Thésée's system enables risk-free planning of future installations and provides real-time insights to co-location clients which benefit from a 3D visualisation of data-centre operations, resulting in carbon emissions (and an energy bill) 30% lower than those of its peers.

Additional examples of environmental and social sustainability benefits for digital infrastructure operators are presented below.

Figure 1: Digital-twin sustainability benefits for digital infrastructure operators



Source: Analysys Mason

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Digital infrastructure operators must overcome adoption barriers to realise the benefits of digital twins

We have identified four types of barriers to the adoption of digital twins by digital infrastructure operators:

- **Economic:** due to model scale and complexity, digital twins for digital infrastructure assets typically incur high up-front costs and can have a lengthy deployment phase requiring extensive adaptation/calibration, delaying investment payback. Furthermore, a lack of 'off-the-shelf' tools due to unique operator requirements results in bespoke projects that are inherently riskier and costlier.

- **Input-sourcing:** the need for specialised technical skills to engineer and run the model, as well as difficulties in obtaining high-quality data can result in less reliable outputs.

- **Stakeholder misalignment:** key stakeholders, including investors, might have low understanding of digital-twin deployment value, sustainability impact and return on investment due to limited exposure to implementation. A lack of regulatory clarity can also reduce confidence.

- **Technology:** lack of technology standardisation can constrain the benefits of adoption due to lower interoperability and trustworthiness. There are also potential security risks in managing sensitive data, especially for data-intensive businesses like data centres.

Accordingly, digital infrastructure operators will need to fully understand the technical characteristics of potential digital-twin deployments to ensure that they have sufficient resources and capabilities to support implementation and communicate the benefits to stakeholders.

To help overcome these barriers, Analysys Mason can support players in the digital space to undertake a structured cost–benefit assessment of potential digital-twin implementations, with a focus on assessing economic and sustainability benefits, understanding costs and risks to develop pragmatic solutions, as well as designing a digital-twin strategy to support technology adoption and competitiveness.

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