

# Is the Transportation Industry Ready for Digital Twins?

By Steve Cockerell, industry marketing director, rail and transit, Bentley Systems

At the start of 2022, I wrote a blog post about [the future of transportation infrastructure is happening now](#) and how, with rapid population growth, urbanization, and the urgent need for significant reductions in carbon emissions, digital twins would be key to building back better. However, is the rail and transit industry—one that is often accused of being slow to embrace change—ready for the type of digital transformation needed to fully realize the potential of digital twins? Have digital twins already taken center stage in what is a complex industry, or is the sector still in the early stages of their adoption and deployment?

## What Is a Digital Twin?

To explore the potential that digital twins provide, it is important to understand what a digital twin is. For many, the definition of a digital twin might just be a 3D BIM model of a physical asset. In our world, that might be a length of track, a bridge, tunnel, or station. However, without a connection between the digital version and its physical counterpart in the real world, all they really have is a digital snapshot of an asset at a given point in time.

In this scenario, not only do users run the risk of one version being out of sync with the other, resulting in rework, delay, and/or increased cost, but they also lose the ability to see the data behind the design, construction schedule, or operational asset, as well as leveraging that insight to enable better decision-making and improved business outcomes.

At Bentley, we define a digital twin as a realistic and dynamic digital representation of a physical asset, process, or system in the built or natural environment. A digital twin connects the physical and digital worlds so that the digital dynamically reflects changes in the physical. A digital twin, therefore, represents its physical counterparts' near or real-time status, working condition, or position.



**Image Link:** [https://cdn2.webdamdb.com/1280\\_cO8MxPRFoEH01I3G.jpg?-62169955622](https://cdn2.webdamdb.com/1280_cO8MxPRFoEH01I3G.jpg?-62169955622)

**Image Caption:** A digital twin connects the physical and digital worlds so that the digital dynamically reflects changes in the physical. *Image courtesy of Bentley Systems.*

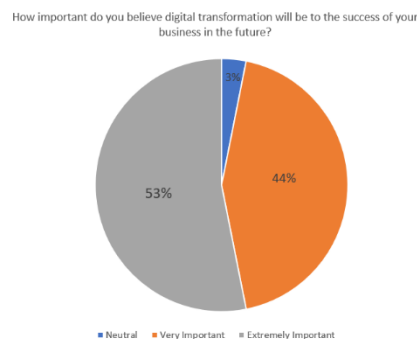
Throughout the asset lifecycle—from concept and planning, through design and engineering, construction and commissioning, and across operations and maintenance—that link, that connectivity, really makes the difference. In this way, digital twins provide improved visualization, analytics, and simulation capabilities. At anytime, anywhere, users of a digital twin can view, monitor, and gather the insight that they need to make the decisions that improve efficiency, reliability, and sustainability.

### Digital Twins in Rail Today

Working with [New Civil Engineer](#), the official magazine of the United Kingdom’s [Institution of Civil Engineers](#), Bentley recently conducted a survey to look at where the industry is today, as well as examine the potential of, and barriers to, the adoption of infrastructure digital twins.

The industry professionals responding to our questions represented every phase of the lifecycle of transportation assets, as well as many of the different specialist disciplines involved. Around 30% were owner-operators or government agencies, while 60% are working within their supply chains as engineers, architects, and/or contractors. The remainder of the input came from academic organizations or technology developers.

Reassuringly, everyone confirmed the urgent need to digitally transform the way that we work. With the backdrop of tighter budgets and shorter deadlines, Bentley knows that organizations are looking for new and innovative ways to drive improved productivity and efficiency, as well the quality of assets being delivered and maintained throughout operations.



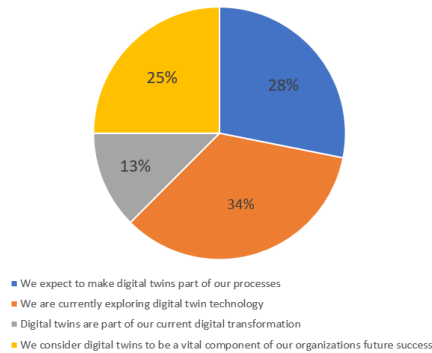
**Image Link:** [https://cdn2.webdamdb.com/1280\\_QdfT2peE991oCNEC.png?1667415918](https://cdn2.webdamdb.com/1280_QdfT2peE991oCNEC.png?1667415918)

**Image Caption:** Importance of digital transformation from rail digital twin survey. *Image courtesy of Bentley Systems.*

When you consider the negative effects of climate change, including the increased frequency and severity of severe weather events that directly impact the safe and efficient operation of our railways, I think it is clear that as an industry, the need for real change is no longer a future problem.

I have written previously about how the global pandemic was a wake-up call for all of us. The experience of the last two to three years has shown what we can do when forced to change. It is also an indication of the opportunity that change provides when part of a strategy versus a reaction to challenges that we encounter in our everyday working lives.

Which of the following best describes your organisation's digital twin strategy today?



**Image Link:** [https://cdn2.webdamdb.com/1280\\_UBdiDOXZCxL62cj8.png?1667415858](https://cdn2.webdamdb.com/1280_UBdiDOXZCxL62cj8.png?1667415858)

**Image Caption:** Organization digital twin strategy from rail digital twin survey. *Image courtesy of Bentley Systems.*

Aligned with this idea, it was encouraging to see that digital twins are expected to be part of their organizations' business processes within the next five years. Furthermore, around a quarter of the organizations surveyed said that digital twins will be a vital component of their future success. The majority, nearly three quarters, also confirmed that they were either exploring the potential that digital twins offered their business or are already in the process of adopting a digital twins approach.

### **Project Delivery versus Asset Performance**

While this insight is great news, what are these organizations doing with their digital twins? Where, within the rail and transit asset lifecycle, does the survey suggest that digital twins are having the most impact? Nearly three quarters of those surveyed indicated that their use was limited to design and engineering. This key phase of the asset lifecycle, along with digital construction, ranked as the top two use cases for digital twins within the organizations represented.

Existing paper-based workflows and/or the lack of direct links to the current or as-built condition of assets were identified as the primary reasons for limited adoption today. This current focus on project delivery was reinforced by an overwhelming majority that felt that 3D design, plus 4D modeling to simulate and optimize construction schedules, were the most important elements of any infrastructure digital twin solution.

Whether through improved collaboration and coordination of teams and with stakeholders, or to enable improved insight and better decision-making, around three quarters of those surveyed felt that digital twins will be the key to optimizing design and engineering outcomes. These outcomes include helping increase productivity, explore more design alternatives, deliver higher quality and more sustainable assets, as well as improve the level of service to their clients and stakeholders.

### **Barriers to Adoption and Deployment**

Clearly, the potential benefits for digital twins in rail extend beyond project delivery. But while asset commissioning and condition assessment, plus asset performance management and optimization, were recognized as key use cases within the survey results, it also showed that there are fewer digital twins in use within operations and maintenance.

Perhaps, the reason for this lays in what our survey found were the biggest challenges organizations face today when implementing digital twins. Very few indicated that availability of digital twin technology was their main barrier to adoption. Most suggest that the biggest obstacles to adoption and deployment were a lack of owner or client buy-in, senior management support, and the perceived cost of setting up and maintaining a digital twin.

As demonstrated through our *Going Digital Awards* entries this year, the evidence that the benefits of digital twins outweigh their cost—particularly when calculated across an asset’s whole life—gets clearer all the time. Indeed, all of the finalists in our Rail and Transit category this year cite digital twins as an important element of their team’s ability to demonstrate excellence across the lifecycle of assets.

In the Philippines, Oriental Consultants Global is working on phase 1 of the Metro Manila Subway Project, developing a common digital engineering system and a single source of truth using Bentley’s integrated technology and digital twin applications. The result is real-time data sharing that has helped optimize collaboration to save 5,000 resource hours within the project’s first six months, as well as already having achieved an ROI of over USD 600,000.



**Image Link:** [https://cdn2.webdamdb.com/1280\\_E9lsR4FV2SI52Iib.jpg?1667416008](https://cdn2.webdamdb.com/1280_E9lsR4FV2SI52Iib.jpg?1667416008)

**Image Caption:** Oriental Consultants Global is developing a common digital engineering system and a single source of truth using Bentley’s digital twin applications. *Image courtesy of Oriental Consultants Global.*

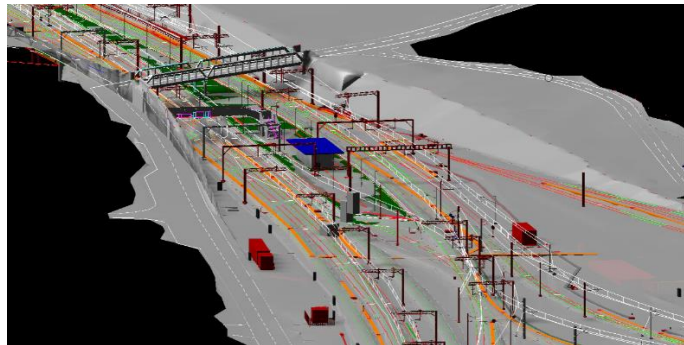
In Jakarta, PT Wijaya Karya (Persero) Tbk is using Bentley’s open civil design and reality modeling applications, as well as digital twin technology, on their work to deliver Indonesia’s first integrated high-speed rail line between Jakarta and Bandung. Its integrated solution has helped streamline workflows that has improved efficiency and design quality, while shortening the construction schedule by six months and saving USD 185 million in construction costs.



**Image Link:** [https://cdn2.webdamdb.com/1280\\_gYX1ucsbU5X81oDI.jpg?1667415953](https://cdn2.webdamdb.com/1280_gYX1ucsbU5X81oDI.jpg?1667415953)

**Image Caption:** PT Wijaya Karya (Persero) Tbk is using digital twin technology to deliver Indonesia's first integrated high-speed rail line between Jakarta and Bandung. *Image courtesy of PT Wijaya Karya (Persero) Tbk.*

In the United Kingdom, Arcadis has used Bentley technology to create a digital twin of Carstairs railway station, located close to the key rail junction dividing northbound trains between Glasgow and Edinburgh, in southern Scotland. Arcadis' use of the Bentley iTwin platform has enabled improved communication among team members, with the ability to detect and resolve clashes early in the design to help optimize the design, while reducing modeling time by 35%.



**Image Link:** [https://cdn2.webdamdb.com/1280\\_sX2XWsbwsQw41cc1.jpg?1667415850](https://cdn2.webdamdb.com/1280_sX2XWsbwsQw41cc1.jpg?1667415850)

**Image Caption:** Arcadis has used Bentley technology to create a digital twin of Carstairs railway station. *Image courtesy of Arcadis.*

### **The Future of Digital Twins in Rail**

With their ability to improve asset performance and reliability, refine maintenance strategies, and explore different options for required upgrades, it is arguably the rail and transit owner-operators who stand to benefit from the greater upside potential of digital twins. While benefits beyond financial can be difficult to quantify, owners rather than the consultants and contractors in their supply chains should still take the lead in defining the value digital twins should deliver.

It will not always be a straightforward process to harness data and technology through digital twins to improve how we work and what we deliver across every phase of the asset lifecycle. However, if they are to become part of our industries' new normal, every organization needs to invest in, and have a clear strategy for, change. As with previous examples of disruptive

technology in our business and beyond, those that do not invest in making and managing this change are more likely to fail.

At Bentley, we believe digital twins are the next big digital disruption in our industry. That disturbance is happening right now—among owner-operators, engineering consultants, contractors, and the organizations that maintain our railways around the world. Digital twins and the different processes that they enable must be embraced to deliver the improved business outcomes demanded in our changing world. While digital twins in rail might not have taken center stage yet, they are waiting in the wings, and with our users leading the way, will transform the way we plan, design, build, and operate our rail and transit networks in future years.

**Author:** *Steve Cockerell is the industry marketing director of rail and transit at Bentley Systems. He can be reached at [steve.cockerell@bentley.com](mailto:steve.cockerell@bentley.com)*