

# Digital Twins central to going digital in rail

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*Skanska, Costain, STRABAG Joint Venture, AREP, and Atkins Join Bentley Colleagues Virtually to Discuss Benefits of Advancing BIM for Rail*

As the world continues to adjust and plan for the new normal of a post-COVID-19 reality, rail owner operators and their supply chains are starting to think about how their infrastructure assets and the workflows that support them will look. With rail and transit remaining one of the fastest-growing transportation sectors globally, assets will need to be equipped to handle social distancing guidelines, which is not an easy task when considering the ongoing challenges of population growth and rapid urbanization. Adding the urgent need to meet carbon neutral targets, while working within tighter budgets and shorter deadlines, you could be forgiven for thinking it an impossible task. However, technology holds the key to the industry's future success.

Virtual press briefings were held in June by Bentley Systems and included representatives from Skanska, Costain, STRABAG Joint Venture (SCS JV), AREP, and Atkins (a member of SNC-Lavalin Group). Each organisation showcased how its use of technology is helping to find success on their own projects, and how important the digital workflows enabled are becoming in lieu of the increased demand for capacity and reliability, amid challenges like tighter budgets, shorter deadlines, and fewer skilled workers—not to mention the extra, but necessary, safety measures needed for colleagues and passengers as a result of

the ongoing COVID-19 pandemic.

The importance of rail in this ever-changing world was highlighted from the very beginning by Steve Cockerell, Bentley's industry marketing director for rail, who explained that rail is the solution for providing more environmentally sustainable transportation of people and products. Fifty-five percent of the world's population is already living in cities—and that number is expected to grow to in excess of 68% over the next 30 years. But it's more than just getting people from point A to point B; it's about doing it in a way that preserves the long-term future of the industry. "Flying is unlikely to be on a lot of people's agenda for the foreseeable future," explained Cockerell, referring to the COVID-19 pandemic, "but it produces more than double the amount of carbon dioxide when compared to standard commuter journeys on rail. Car journeys produce a staggering 28 times for carbon dioxide than high-speed rail. Regardless of whether it is for short distances within cities, or longer journeys between them, rail and transit is key to a more sustainable future for all."

With all these challenges, it is clear that, as an industry, we simply cannot carry on doing what we have always done. We have to work smarter, and embrace the opportunity that technology provides, including through the use of digital twins, that holds the key our future success. Many organisations have realised this, and are choosing to implement new technology as part of a wider digital transformation of their business, and seeing real benefits. And now, with COVID-19 causing global lockdowns, this digital transformation is being accelerated, generating increased demand for communication and collaboration. "Bentley's digital twin capabilities are already enabling organisations to visually immerse their teams in the decision-making process, run various analytics to predict and produce different outcomes, and to track and manage the constant change that happens not just on our projects, but through the asset lifecycle of rail assets," said Cockerell. "Enabled by the convergence of engineering technology and its deliverables – the specs, drawings, models, and analyses produced during design and construction, with operational technology providing live or near real-time data streams from IoT connected devices like sensors or drones, and information technology to track change, identify asset types and location plus maintenance history, it's the connectivity that allows users to connect physical assets in the real world with their digital counterparts, the digital twin, that really makes the difference."

To give a concrete example of this positive difference, Peter Ruff, BIM manager at SCS JV, and Roberto Alberola, BIM information manager at TYPESA UK/SCS Railways, explained how they have been using Bentley technology and a digital twin approach on their work for the High-Speed Two (HS2) project in the United Kingdom. SCS JV has been working on this project for four years with its design house, another joint venture with Arup, TYPESA, and Zubin. With this many organisations and team members needing to collaborate on an already complex project, connectivity was key.

"The goal is to design, construct, and maintain the railway digitally while also saving the government GBP 250 million," Ruff explained.

Alberola added, "We needed to build a system capable of the digital delivery of this project."

SCS JV is using various Bentley applications—including OpenRail Designer, OpenBuildings Station Designer, and SYNCHRO—to model the design and simulate construction, while a ProjectWise powered connected data environment helps house all data in a single location. Through its digital twins approach, the

multidiscipline team is better able to visualise the design and run analytics, leading to earlier detection and resolution of clashes to avoid rework, save time, and minimise delays. Working in this way is also opening up new opportunities on the project, enabling the team to derive estimates directly from the data and models, not only for material quantities but also for carbon emissions.

“The 5D approach was a fundamental feature in allowing us to achieve this,” said Ruff. “It allows rapid analysis and creation of the carbon footprint generated by the design, which could be used to optimise construction from a carbon perspective, as well as cost. This process has been seen as industry leading due to its speed and accuracy compared to traditional methods. This is only really being made possible by going digital.”

“Our data quality went up to 98% when typically, it would be around 20%, 30%, or 40%,” Alberola said. “Planners estimate that using 4D allows for a 30% reduction in planning time. To date SCS has accounted for over GBP 3 million worth of savings with this digital portfolio.”

Both Ruff and Alberola acknowledge that there is more that the joint venture can do to continue in going digital. Moving forward, they want to unlock the power of Bentley’s OpenRail connected data environment (CDE) and continue to automate processes. “I wouldn’t say that we’ve gone digital yet,” said Ruff. “But we’re working hard to get there.”

At AREP, a subsidiary of SNCF France’s national rail owner operator, teams are working to develop and improve public infrastructure in the country’s rail industry to enhance user experience. As Baptiste Frioux, a project manager in the flow and mobility team, explained, “Our team is composed of many architects and urban planners, but few of us are specialised in people’s mobility. We need to make sure that the design corresponds to the needs of our customers.”

Frioux and the team used LEGION, Bentley’s pedestrian simulation software, to help make that connection on the St. Lazare train station renovation project in Paris. The team wanted to develop a mixed-use building that would not only provide a station to connect the suburbs to Paris’s Metro network but also a shopping centre for the neighbourhood to use and enjoy. LEGION allowed Frioux and the team to develop video simulations of different scenarios to show team members and shareholders how to enhance user experience of people in the station while also maximising the commercial opportunity for businesses within them. Frioux explained that it was easy for them to make changes in the digital twins, showing how you can highlight where there are weak points in the design or where there might be discomfort for users trying to walk through the space. He and the team were able to test different strategies and designs to see what the best option would be.

“[Our digital twin] is a fairly comprehensive and useful tool for our job. The more we are moving to the digital world, the easier, the quicker, and the more accurate we will be able to walk. Bentley is working on that, and it’s always good to have their innovations.”

Cameron MacDonald, technical director from Atkins, also spoke about his experience working in a digital environment. The organisation has used LEGION on many projects in the United Kingdom, Australia Hong Kong, Saudi Arabia, Dubai, and China. Recently, due to the COVID-19 pandemic, his team at Atkins has shifted its focus to thinking about social distancing and providing ways for people to move through stations

while still maintaining the proper distance from others. MacDonald and the team at Atkins are beginning to look at pedestrian behaviour data and analysing how it differs between pre- and post-COVID-19 outbreaks, modeling the differences.

"I can simulate the use of waiting circulation and queuing zones with entities responding directly to visual cues for social distancing," MacDonald explained, referring to how public spaces are providing one-way signs on the floor or blocking off sections to reroute pedestrian traffic. "Atkins is committing to a digital future with ongoing investment into digital solutions that have the potential to transform infrastructure delivery. Part of this aspiration is to embed simulation models within a digital twin at the design stage. As the project lives on, we have an opportunity to model any number of operational scenarios to optimise the use of assets over their lifetime."

Other Bentley colleagues also spoke at the press briefings, discussing where they see Bentley heading as they continue to support their users in going digital. Eduardo Lazzarotto, director of product management, talked about how a digital environment can lead to increased reliability and optimised performance from the very beginning of a station's asset lifecycle, ensuring that it remains fit for purpose throughout its entire operational life.

"We can use simulation technology to understand where to position shops, different types of activities, or queuing systems, barriers, staff, and other operational plans to actually run the station," Lazzarotto explained.

Then, during construction, users can ensure that there is not only safety and comfort of passengers but also energy efficiency of the space. Teams can implement a timeline of the project and guarantee that they are still operating and running their assets optimally. Moving on to operations, Lazzarotto showed how the information generated during design and construction can be consumed within a digital twin for operations.

"We can use that data to create different what-if scenarios of the future operations of that space. We can start improving it and delivering more out of that asset overtime," he said. "And that data can be used not only to operate the assets, but to also take those assets forward to new projects or develop and prepare them for the future."

Teresa Elliott, industry marketing director for smart cities, talked about how digital twins can benefit an entire urban area, using the example from the city of Helsinki and its digital twin to support multiple ongoing projects within the city. With its citywide digital twin, everyone can see projects being planned and in progress in the city. Elliott also mentioned the city of Gothenburg, which is planning to accommodate 150,000 new residents and 80,000 new homes and offices by the year 2035. The city is using its digital twin to visualise an important rail project for the city, including renderings of what the stations will look like and bringing BIM data directly into this environment. This highly visual model makes for clearer communication and allows for citizens to be involved earlier in the planning stage, helping to avoid misunderstandings and even formal complaints that might delay projects.

However, as Elliott pointed out, "It's not just about communicating outward to the citizens, but it's also about getting feedback [from them]."

She explained that in Norrköping, a smaller Swedish city project, the team is using the digital twin to capture urban planning ideas and direction from its citizens. "It's a fast, easy, and visual way to successfully communicate, promote, and share those projects," she said. "This is not just top-down planning and communication, but it's also bottom-up inclusion and input. All of these examples show a clear and compelling way to visualise and communicate city plans and projects to engage stakeholders."

The press briefings concluded with a question-and-answer session. One topic discussed was how advancing BIM through digital twins supports the design and construction of rail networks around the world. The team from SCS JV explained that using a digital twin of the railway allowed them to analyse and support all the teams that were working together on the project.

Further dialogue included conversations about how digital twins can help rail stations become more resilient in times of accelerated change and with constant disruption, and highlighted how Bentley applications like LEGION can make it easier for organisations to react, adapt, or even predict these changes. In spite of all the complexities that designing, building, and operating these critical assets in whatever our new normal may bring, digital twins look set to be part of going digital in rail for many around the world, in the (not-too-distant) future