

## APPLICATION OF THE DIGITAL TWIN TO CONSTRUCTION PROCESSES (VIAS)

Digitalisation is changing the way projects are planned, built, and managed. BIM is a collaborative working methodology based on 3D models that provides everyone involved in construction with the views and tools they need to carry out each phase in the most efficient way. This methodology offers its full potential when its features are exploited in real time, and when data can be captured in an automated, or at least partially automated, manner. Compared to a "static" BIM model, a "Digital Twin"—which is nothing more than processing the BIM model dynamically—can provide valuable information to improve production processes, such as up-to-date data on resources during construction (facilitating control over personnel, material and machinery), an up-to-date cost forecast based on the detailed actual development as the work progresses, etc.

In this line of work, VIAS aims to develop the potential of the Digital Twin, monitoring the critical parameters that condition the evolution of the work as a tool for planning works and resources, offering greater flexibility and productivity. In addition, efforts are being made to implement specific functionalities focused on improving worker safety through automatic risk detection, and other technologies such as virtual reality and augmented reality are being tested.

For automated - or at least partially automated - data capture, which is one of the main keys to progress in this line, drones and laser scanners with some ground mobility are used, as well as fixed sensors to monitor the parameters that are defined as critical. By comparing the captured information with the starting model, deviations are detected and finally the underlying BIM is updated. Automating this workflow as much as possible, which currently still has a large manual component, is another key to extending the application, and is currently a priority line of development.

VIAS is focusing on developing this technology both for its construction and maintenance of linear infrastructures and for its building works, having developed several use cases for this purpose.

For railway works, the digital twin is being equipped with new capabilities by combining it with geographic information systems (GIS) in view of the need to incorporate linear spatial referencing to manage the information. The latest advances in BIM-GIS integration and the BIM Railway Classification System SFCclass V2 - developed within the scope of the Railway Innovation Hub (RIH) - will be very useful tools to accelerate the evolution in this line of work, promoting the development of digital twins applied to railway infrastructures, and thus the digitisation of their construction and maintenance processes.



BIM IMPLEMENTATION, VIAS, SPAIN - © DRAGADOS

## DIGITUN PROJECT (DRAGADOS)

The DIGITUN Project: "DIGITALIZED FIRE SAFETY FOR RESILIENT UNDERGROUND CRITICAL TRANSPORT INFRASTRUCTURES" is part of the 2022 call for PUBLIC-PRIVATE PARTNERSHIP PROJECTS within the Digital World, industry, space and defence thematic priority and was co-funded by the Ministry of Science and Innovation as part of the State Programme to Promote Scientific and Technical Research and its Transfer, of the 2021-2023 State Plan for Scientific and Technical Research and Innovation, within the framework of the Recovery, Transformation and Resilience Plan. The project is being implemented from 2023 to 2026, coordinated by DRAGADOS, with the participation of Catalonia Polytechnic University (UPC) and Sener.

The main objective of the project is to increase the level of protection in tunnels against extreme fires, and to identify and quantify the level of damage to the tunnel lining after a fire, to determine the most sustainable repair/reinforcement work.

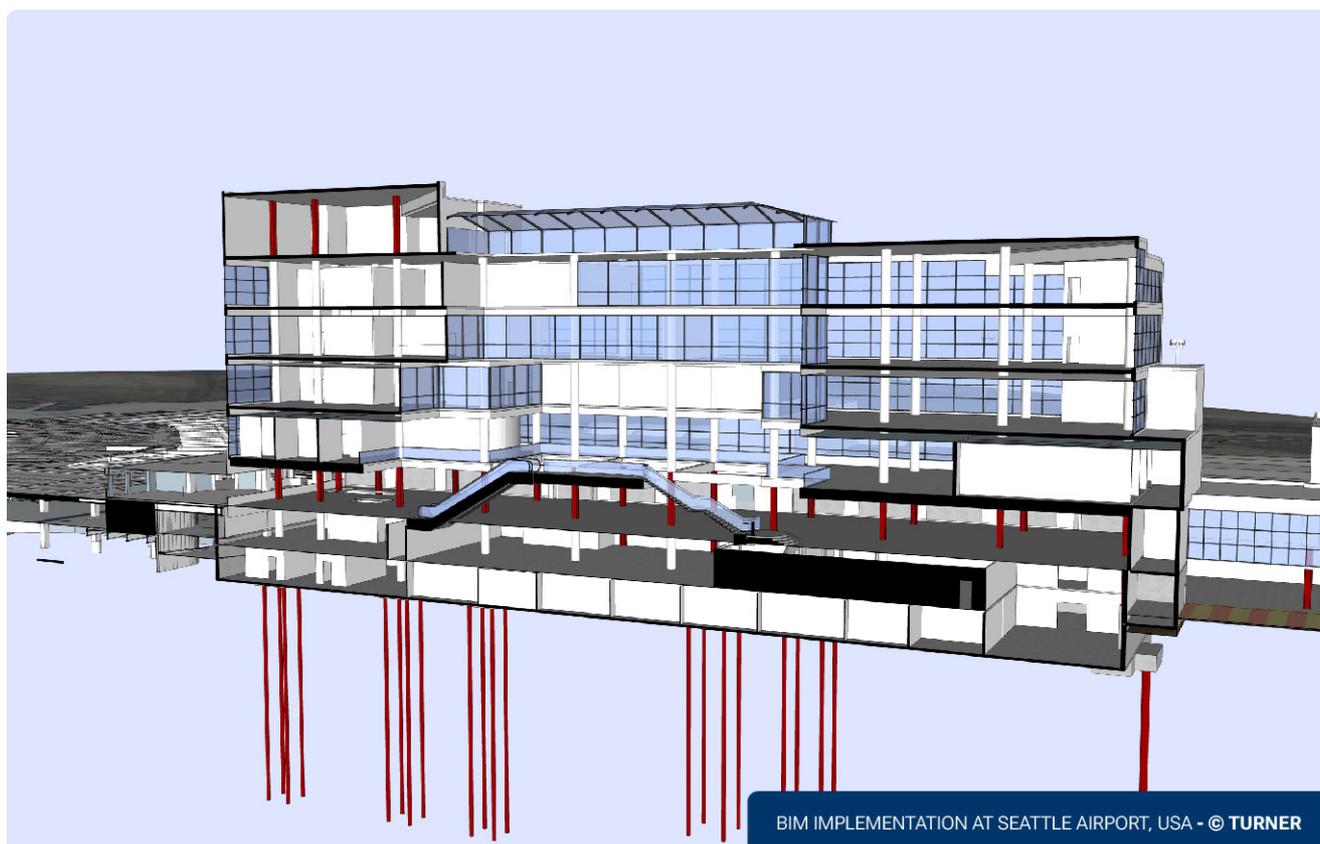
Since this sensor and AI-based system can be installed in both existing tunnels and new tunnels, there is excellent market potential for this new technology to be developed in the context of DIGITUN.

To this end, the project is using industrial expertise and technological assets (sensors and smart platforms) and advanced structural reliability models to improve the structural assessment of tunnels after a fire and to optimise the repair/demolition strategy in terms of sustainability (environmental and economic).

More specifically, the project proposes using wireless sensors to record the temperatures reached inside fibre-reinforced concrete elements (precast segments and shotcrete supports) under real fire conditions. Once calibrated and validated, a methodology will be developed, based on using these temperature sensors, for structural fire repair and/or reinforcement, i.e. increasing the level of safety against extreme fires, which allows, through an intelligent digital platform, to record, correlate, analyse and visualise the data obtained from the wireless sensors in real time, for subsequent decision-making related to repair/reinforcement operations, thus being able to evaluate and quantify the sustainability performance (economic, environmental and social) of the digitised concrete tunnel linings.

Determining the traceability in a fire event, when the tunnel lining has to be repaired or demolished, not only facilitates the diagnosis, but also enhances the recyclability of the materials.

In a complementary way, critical production operations (demoulding, steam curing process) will be optimised to improve productivity and quality control during the manufacturing of concrete coverings based on real-time temperature readings provided by wireless sensors, avoiding premature damage due to cracking, before installing segments during curing (stockpiled segments), storage and transport due to severe environmental conditions.



## NEXPLORE (HOCHTIEF)

HOCHTIEF is working with ACS and the Group's operating companies to actively promote digitalisation in its main activities through the company Nexlore, created in 2018. Nexlore is a digital transformation incubator and accelerator that takes advantage of the existing digital innovation capacity within the ACS Group.

Nexlore combines cutting-edge research with front-line institutions and world-class technical capabilities to enhance collaboration and progress in the sector worldwide, including innovation and digital development centres. The aim is to make the most of the opportunities offered by digitalisation for the business, such as artificial intelligence, virtual reality, the Internet of Things and Industry 4.0.

In 2023, 250 Turner experts and partners participated in the eighth Turner Innovation Summit. One of the main themes was: "From Artificial Intelligence (AI) to Intelligence Augmentation (IA)". Practical application of the Nexlore DeliverEze platform, which facilitates the delivery processes in large projects.

### Nexlore DeliverEze

Nexlore DeliverEze is a streamlined delivery scheduling platform that allows field teams, suppliers and all other parties involved in the on-site delivery process to schedule, track and manage their deliveries all in one place. DeliverEze was initially developed as a project-based system for Turner and was used to closely track and manage supplier deliveries in government works. Version 1 was launched in November 2021 and was used in 16 Turner projects with a total of 250 users. As a result of the initial release, Nexlore was able to gather valuable feedback from both project teams and suppliers and thus obtain important information for the enhancements of version 2.

Since October 2023, this new version has been used in four internal projects involving a total of 60 users from Turner, Flatiron and Leighton Asia. DeliverEze has already contributed considerable value to these projects: For example, the platform helped streamline communications with suppliers, minimise delays due to on-site frictions and mitigate safety risks during the delivery process. Nexlore will improve these aspects in future iterations and thus extend its reach across the Group and beyond.

### Nexlore Concrete

Nexlore Concrete, a digital solution for concrete ordering, delivery, quality control and documentation, is currently being implemented on two major construction projects in New South Wales, Australia, involving CPB Contractors: The first project, the M12 West motorway, is a NEWest Alliance venture. The second project, the Perth Metronet, will improve the region's transportation network. The Nexlore solution connects everyone involved in all phases of the concrete life cycle. It thus serves to optimise the entire concrete construction site. In December 2023, the pilot phase of Nexlore Concrete deployment began for both projects. Both projects are using the QR code functionality in Nexlore Concrete to manage data digitally.

The system was upgraded to interface seamlessly with Australia's four major concrete suppliers, ensuring a smooth and collaborative workflow between all those involved. Since the beginning of 2023, Nexlore concrete has been successfully used in 15 HOCHTIEF projects. Recently, the solution has also been equipped with a real-time cross-project evaluation function with Microsoft Power BI.

## DYNAMIC VIRTUAL REPRESENTATION OF CONSTRUCTION PROJECTS: BIM AND DIGITAL TWIN (HOCHTIEF)

Innovative technologies continue to affect the landscape of the construction sector, and at the forefront of this evolution are two interconnected technologies as a foundational pillar: Building Information Modelling (BIM) and digital twins. These advanced digital tools combine not only to transform how buildings are designed and built, but also to revolutionise their operational efficiency and life cycle management. Integrating these tools marks a paradigm shift in the way structures are conceptualised, created and maintained, promising maximum precision, foresight and optimisation throughout the life cycle of a building. BIM, which fits in seamlessly, prepares the ground with comprehensive data, while digital twins use real-time information to create a dynamic replica. Together, they streamline the entire life cycle of a structure, providing not only greater efficiency, but also predictive information for proactive maintenance.

With the help of software, the three-dimensional plans are linked with additional data such as time and cost schedules. BIM allows the progress of construction to be monitored in real time and improves the planning process. The resulting data can be used to optimise the maintenance and operation of buildings and infrastructure projects. BIM is also an important tool to reduce the risks related to construction. At HOCHTIEF, the subsidiary HOCHTIEF ViCon has the specialised knowledge on BIM. As a service and consulting provider, the Company provides support to internal and external customers in the use of BIM.