R&D INTERMODEL PROJECT (VÍAS)

In the R&D INTERMODEL project, of the European Horizon 2020 framework programme, it has been possible to develop a platform to support decision-making through the integration of combined digital technologies for the design of multimodal rail freight terminals. The result is a great potential tool to effectively contribute to the development of freight transport by rail of the future, and therefore to fulfil transport sustainability commitments.

The configured digital environment is based on the integration of advanced simulation modules with specific BIM technology, capable of dynamically interacting to assess the performance of the terminals and their interconnections, supporting decision-making in both the design and planning and operational phases throughout the life cycle of these infrastructures. This makes it possible to address the optimisation of operations and improve key aspects such as track maintenance, mitigating their very high degradation and, therefore, increasing their useful life.

The digital environment based on BIM and advanced simulations developed considers both static and dynamic indicators (CAPEX - capital expenses -, OPEX - operating expenses -, programming and cost of maintenance, energy efficiency, productivity and environmental impact). In accordance with these indicators, several existing intermodal rail freight terminals have been assessed, including the latest trends in the logistics sector. The result contributes to defining the "Railway Freight Terminals of the Future.'

The line of work for optimising track maintenance, which is key to the sustainable operation of rail freight infrastructure, has been led by Vías in the project, achieving results that allow the superstructure to be digitalised in the terminal environment and in the interconnection between terminals with a degree of automation not reached to date. This is an advance towards unprecedented predictive rail maintenance.

To this end, Vías has introduced autonomous mass data capture equipment that is both compact and can be carried on any railway vehicle, based on sensor mergers, which autonomously carries out the inspection and monitoring of the status of the key elements of the road. The equipment, which was developed in-house, integrates cameras, laser sensors and another series of specific sensors that characterise geometries by digitalising the infrastructure. Efforts focused on the segmentation and automatic identification of geometries from the mass processing of the data captured, and subsequently contrasting all digital information for the detection of changes over time based on the evolution of point and image clouds in successive inspections. In this regard, several algorithms have been developed to automatically extract items from the enormous amount of data from point and image clouds, as well as overlapping results over time.

The tests were carried out on various sections of the Spanish rail network, as well as along the interconnection of the Port of Melzo with La Spezia (Italy), approximately 300 km long.

The combination of the proprietary inspection equipment for autonomous and massive data capture with the advanced processing of information through the new segmentation and comparison algorithms developed has been a milestone in the digitalisation of rail transport infrastructures and a significant progress towards their predictive maintenance.

RESEARCH INTO TEMPERATURES AND MATERIALS FOR THE LA PALMA ROAD (DRAGADOS)

As a result of the volcanic eruption in the Cabeza de Vaca area in the municipality of El Paso on La Palma Island between September and December 2021, some of the island's transport infrastructure was damaged or totally destroyed, with North - South communication being completely disrupted in this area. To restore part of these infrastructures and connect the towns of Puerto Naos and Fuencaliente with Los Llanos, Tazacorte and El Paso, the Ministry of Transport, Mobility and the Urban Agenda awarded DRAGADOS the emergency works for the construction of a road segment to be partially executed on the lava streams generated by the eruption. The section that mainly runs through the lava streams connecting the LP-213 to the LP-215 is a conventional road, 4 km long, with a project speed of 70 km/h with a single carriageway and one lane per direction, of which 2.4 km are built on lava.

The main factor that places restrictions on the construction works is the high temperatures existing in the lava streams area, which on the surface could range from 150º to more than 350º at a depth of 1 m and up to more than 450º at a depth 3 m depth, since the works were performed only six months after the end of the eruption. These temperatures affect both earthworks and road elements, especially the packing of the road surface.

In order to design and plan both the road layout and the construction work, extensive research had to be carried out to find about the behaviour of the lava streams. Some of the main research was a study of the temperatures along the axis of the route, both on the surface and at different depths, by installing thermocouples, flying an infrared camera, with the aim of obtaining a surface temperature map and a geophysical research campaign through georadar to locate areas with hollow spaces, such as glass tubes and homes over which the lava had flowed, which could result in area of collapse both during the works and during the subsequent operating phase.

Another point that has required significant research work was the selection of materials to build embankments. Since these are newly created materials from the volcano flow, numerous tests were necessary to verify their suitability and a novel design that facilitates dissipation and isolates the heat from the lower layers.

The surface layer also posed a significant challenge to ensure its performance over time and the safety of vehicles travelling on the road. To this end, an innovative design for the surface packing was carried out, with numerous tests carried out both in the laboratory and in test segments, with the aim of selecting the best options for the construction of the road, verifying both their performance from the structural point of view and the constructive process.

EXPANSION OF BIM CAPABILITIES (HOCHTIEF)

Building information modelling (BIM) is the digital tool of the future for executing projects. Customers from various countries are now demanding that BIM be used in the design and construction of projects. The methodology is based on actively connecting all people that participate in a project using 3D computer models that can be detailed with additional information.

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. HOCHTIEF's subsidiary 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.

The Group companies regularly use BIM in their main construction projects; to date, HOCHTIEF has accumulated BIM experience in several thousand projects throughout the Group. The objective is to use BIM in a generalised way. To this end, the BIM4HOCHTIEF training campaign launched in 2018 by HOCHTIEF's ViCon subsidiary continued in 2022. The "BIM Project Circle" serves as a new internal medium to report on the current status of the initiative and exchange information; for example, on the integration of standardised BIM use cases into the management system. A total of 4,641 employees throughout the Group (2021: 2,842) received additional training on the latest iteration of this technology in the year of the report. Since 2019, a total of 55 BuildingSmart certificates have been awarded to HOCHTIEF employees in Germany. This allows customers to have their demand for certified BIM experience met. To train BIM professionals, HOCHTIEF ViCon also collaborates on programmes on this matter with Ruhr University Bochum and the Technical University of Munich, among others.

HOCHTIEF PPP Solutions and HOCHTIEF Vicon received the "BIM Champion 2022" award from Building SMART Deutschland for their successful work with BIM.

NEXPLORE (HOCHTIEF)

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

Nexplores combining 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.

Nexplore productivity

This digital tool captures the overall state of a construction process with the naked eye within a cloud platform that allows users of the tool to capture, review, compare and view all project data in a single, centralised system. The tool thus provides a clear picture of the overall status of the project, helps to identify and follow design problems, as well as to visualise, process and analyse point clouds for infrastructure projects. The tool simplifies productivity management in complex projects with clear visibility of the overall state of the project, allowing users to review the actual progress with regard to the timing and actual costs with regard to the budget.

Nexplore Minerva

The Nexplore subcontractor management tool brings transparency and control to the supply chain. A centralised tool captures, stores and processes the current status of all projects and all contractors, subcontractors, suppliers and associated consultants in real time. A digital process provides data analysis and accurate forecast of payments. Therefore, all dates, variations and forecasts of completion can be displayed on a single view. This eliminates the laborious manual verification of all deliverables.

Resilience of the Nexplore supply chain

This is a database for the continuous analysis and identification of disturbances in the supply chain. The verification includes non-confidential information on the supply chain and shares it with users. Linking with analytical data makes it possible to improve the preparation of reports with updated control tables to detect disruptions in the supply chain. Comparative reports are available to manufacturers, suppliers and product lines. The tool replaces complex internal process systems and puts an end to late notifications of delays in deliveries and the lack of visibility of disruptions in the supply chain.

Nexplore Security Camera

The Nexplore Chamber of Safety is a flexible and scalable proximity vision solution with AI technology to detect the presence of people and alert them to construction works. Developed especially for the construction sector, it mitigates the security risks around mobile facilities and reduces reliance on human supervision. A proximity visual and sound warning system helps to avoid collisions in the work. Up to eight ultra-modern HD cameras (180º) per unit guarantee coverage without blind points. The cameras operate in various light and weather conditions and are compatible with a wide range of vehicle types.

Nexplore Deliveries

Nexplore Deliveries is a unique tool for all parties involved in the logistics of a project to schedule and approve deliveries in the available time slots. The platform provides a detailed overview of all planned deliveries, materials and number of vehicles, with notifications of the status of deliveries for all those involved. The works are therefore efficiently and safely supplied, and materials can be monitored from start to end.