

NEXPLORE

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

Nexple 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.

Nexple 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 visualize, 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.

Nexple drone services

This digital product provides continuous and accurate monitoring of progress in construction works through the use of drones. The process is significantly more efficient and accurate than conventional methods, and simplifies documentation with the availability of reliable data. It also improves work safety, especially when deployed in difficult terrain. Other benefits of the system are that it ends the lack of data in remote or inaccessible areas, provides a solid basis for decision-making and prevents unforeseen costs due to unforeseen mass movements.

Nexple quality control

This digital and modular system encompasses an increasing range of functions, such as inspection management, quality alerts, photo loading and exchange, task and fault management, electronic forms and the work journal. It offers a cost-effective and flexible solution for the various stakeholders of the project, such as contractors, subcontractors, consultants and customers. Nexple Quality Control replaces error-prone processes, such as data collection based on forms, communication and archiving.

Nexple Security Camera

The Nexple 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 (180°) 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.

Nexple Deliveries

Nexple 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.

AUTONOMOUS ROBOTICS FOR INSPECTION AND EVALUATION OF EXISTING BUILDINGS, WITH BIM TECHNOLOGY (DRACE GEOCISA)

The overall objective of the project was the development of an automated, active and multidisciplinary technology for inspection, assessment and diagnosis of the composition and state of conservation and energy efficiency of buildings, which facilitates the obtaining of accurate and sufficiently detailed information on the constructive systems and pathologies as well as a thorough analysis of the building.

The new automated system is based on the use of a light and autonomous mobile robot, both in its displacement and in its feeding, with the ability to access any part of the envelope. In addition, it can be operated remotely. The new tool has the capacity to exchange specific measurement elements (endoscopy, ultrasound, georadar, metal detection, corrosion, thermohigrometry) and action (pressure and/or sensor installation) on the envelopes of the buildings.

The specific project developments are:

- Integrated autonomous robot - a mobile structure capable of accessing any surface of the envelope of a building and move through it.
- Integrated autonomous robot with high possibilities of accessibility for inspection anywhere on the façade.
- System of interchangeable items as instruments for inspection tasks.
- Mobile robot positioning system on vertical surfaces.
- Geometric data collection by the Robot and automated raising of the envelope in the BIM model.
- Creation of a BIM model own injury database.
- Interconnection with the building maintenance and operation systems.
- Software BIM navigation and export.

The project has a high degree of innovation and technological risk that includes numerous challenges in order to overcome the current barriers and achieve a competitive improvement in the conservation and rehabilitation of the existing buildings, leading to significant progress in the identification, assessment and early diagnosis of building envelopes.



OPTIMISATION OF THE FUNCTIONING OF TUNNELLING MACHINES (TBM) THROUGH PHYSICAL MODELLING AND ARTIFICIAL INTELLIGENCE (DRAGADOS)

The objective of this project is to provide real-time operational intelligence to tunnelling machines (TBM) to improve their performance, reduce risks and their operating cost.

To achieve this, the project uses two types of techniques to analyse the performance data of the tunnelling machine:

- a. Analysis based on physical models of the various components of the tunnelling machine that feed on the data generated by the machine and the work as the excavation takes place. This technique is used when the Physics of the system that will be analysed and models can be simulated to predict the performance of the machine are well known.
- b. Analysis based on Artificial Intelligence based on the data of the TBM and the work as they are generated. Sometimes the physical modelling of the tunnelling subsystems is elusive. This means that even if it is possible to define a physical model, the results may have a high degree of uncertainty or the input parameters may be difficult or impossible to measure accurately. In this case, automatic learning techniques (Machine Learning, Deep Learning) can be used to predict TBM performance.

The final result sought with these two types of systems is to make operational adjustments to optimise the performance of the tunnelling machine. That is, "operator assistance" is implemented from much more complex information than that which an individual can reasonably handle in real time. It is a conceptually similar system to advanced driving assistance systems that are beginning to be seen in modern cars.

There are a number of areas in the field of excavation with TBM that can assist the operator and improve the machine's performance, including the following:

- Optimisation of soil conditioning.
- Deformation control.
- Optimisation of the rate of progress.
- Prediction of the land ahead of the machine, which allows risks to be anticipated.
 - a. Detection of anomalies.
 - b. Control of tool wear and planning of interventions.

To prove that the results of the project are those expected, the improvement that these techniques provide on the regular performance of the tunnelling machines must be measurable in terms of improving the various parameters of the tunnelling machine, material savings, cost reduction or other variables of the work that may be of interest in the execution of the project. This project is currently being developed in DRAGADOS and DRAGADOS USA in collaboration with the Colorado School of Mines as a research centre and has been implemented in Los Angeles Effluent Outfall's work in the US. Its next implementation is expected in Hampton Roads and Chesapeake projects.



EXPANDING BIM CAPACITIES AT 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. Based on this model, project participants can also calculate the carbon footprint and possible savings.

HOCHTIEF recognised this potential from the outset and founded the company HOCHTIEF ViCon GmbH, which specialises in these methods. The objective is to make HOCHTIEF ViCon the BIM expert for all of HOCHTIEF, offering courses in this area for the company's own employees as well as providing courses to other companies and serving as a consultant and adviser specialised in BIM for projects undertaken by the public administration or private companies. In addition, BIM is already used in many HOCHTIEF companies.

The development of innovative applications for building information modelling (BIM) continued to be a common long-term focal area for all corporate units in 2021. During the year, the total number of employees trained in the most recent iteration of this technology was 2,842, compared to 5,973 in 2020. To train BIM professionals, HOCHTIEF ViCon collaborates with Ruhr University Bochum and the Technical University of Munich, among others. Training and use of these new technologies is necessary to offer sustainable products and services when meeting clients' needs and, therefore improve their positioning in the market.

