

Metro Line 5
Bucharest, Romania

SIXENSE

Final stretch

In 2016, Sixense continued to work on the metro extension project in Bucharest for the Metrorex public company. The teams supplied and installed a complete detection and monitoring system, and they continue to carry out uninterrupted real-time monitoring of site impact on the environment. This is a particularly innovative project in the country that marks the first application of automatic geotechnical instrumentation technologies. The project includes monitoring of ground deformation, buildings and structures in the vicinity of the works via nearly 30 precision Cyclops and Centaur 3D systems. The Atlas monitoring technology, used for the first time in Romania, is based on analysis of satellite images made up of 230,000 measuring points, is used to track ground settlement. Experts monitored groundwater by means of piezometers and tracked ground deformation by placing inclinometers in drill holes or extensometers along the tunnel boring machine (TBM) alignment to measure settlement during and after passage of the TBM as it carries out excavation works. All data is centrally compiled in a single software platform, Geoscope, which is used to process, display, report and archive data, and issue automatic alerts. This is a major step forward in risk management. This is the final stretch for the construction work on the first section of Line 5, which started in 2011. The new line will cross the city west to east and is expected to carry more than 19 million passengers per year.



BRUNO LANCIA
Chief Executive Officer,
Sixense

Focus on the entire infra-structure life cycle

How does the creation of Sixense in September 2016 affect Soletanche Freyssinet?

The launch of a brand covering a new business line and reflecting the decision to position the Group around the world is an unusual event in an industrial group. However, this new brand was not created from scratch. It brings together 10 specialist companies with more than 20 years' experience, some of which, such as Soldata, already have an international reach. They are all grouped under a common identity and strategy.

Why did you bring them together?

Each had its own expertise, but all these companies are working in the same field – optimisation and monitoring of infrastructure, soils and their environment. The goal is to give them more visibility, and to continue to expand them, within their business activities, in France and abroad. And above all, by combining their expertise, we are building new services and solutions for our clients in which digital technology is the flagship component.

A watchword for 2016?

Creation: since we launched our new worldwide Group.

Your figure for 2016?

6, of course! The 6 in Sixense, the sixth Soletanche Freyssinet brand that gives our clients a "sixth sense" in understanding their structures.

Your ambition for Sixense?

To be a Group of world-class excellence in digital solutions and consultancy specialising in infrastructure design, construction and operation.

In what way is the Sixense solution different from that of its competitors?

Many companies specialise either in digital technologies, in engineering or in a specific stage in the life cycle of an infrastructure project. Sixense supports its clients throughout the structure's life cycle, with the goal of enhancing its reliability and durability. To do this, its services include diverse engineering and state-of-the-art digital solutions that can be used to optimise design-build construction, analyse the structural behaviour over time, anticipate changes and make the right risk-cost trade-off at any point in time. In addition, we offer not only innovative tools but also the services that go with them, in other words analysis, advice and technical support. In digitally modelling data collected by the sensors installed in structures, we are making predictive maintenance a reality. The scope of work that is opened up is huge. The point is to avoid failures and deterioration before they occur. This detailed knowledge of structural behaviour also makes it possible to optimise the design of new installations. It amounts to a virtuous circle based on digital instrumentation and data mining – the "big data" approach... →



Expertise at the heart of digital services and solutions

The Sixense Group offers digital services and solutions specialising in infrastructure, soil and the environment in order to understand, analyse, anticipate and optimise clients' investments. Sixense's principal mission is to provide support to designers, builders, operators and infrastructure owners in order to successfully overcome three challenges facing them: construction project management, asset management, risk management.

21
COUNTRIES (LOCATIONS)

600
EMPLOYEES*

*Number of Sixense employees in the first quarter of 2017

NEW ORDERS

- Monitoring and instrumentation on the Eole project, La Défense, France
- Monitoring and instrumentation, Purple Line, Maryland, United States
- Asset management software for Anglo American's mines in South America, North America, Africa and Oceania
- Asset management software for all bridges in the province of Ontario, Canada
- 3S seismic operation, extension of metro Line 14, Paris, France
- Monitoring of waterproofing coating works (composite skin) on the extrados of EDF reactor buildings at nuclear power plants in Flamanville and Civaux, France

Another goal: developing collective intelligence...

Our digital tablet and smartphone based solutions optimise construction project management, as in Digital Site (see page 79), and infrastructure management, monitoring and maintenance, as in ScanPrint (see page 82). With this type of devices, which are fully adaptable to the needs of our clients, all project stakeholders are able to share information and feedback in real time across distances. Not only do we thereby increase overall intelligence to serve the project, but we substantially shorten decision-making circuits. Another advantage of these solutions is that they ensure "zero paperwork" and data collection.

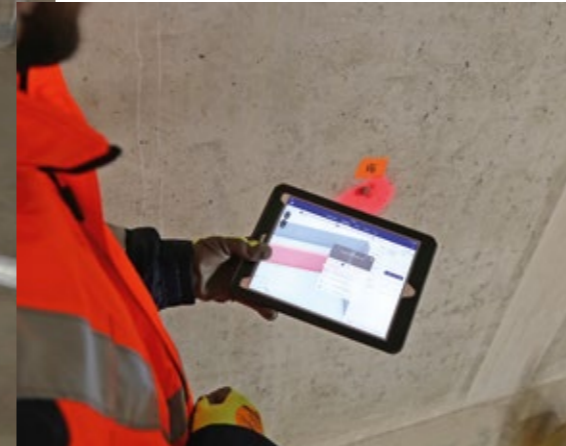
What are the new market opportunities for Sixense?

Buildings, transport infrastructure, energy and nuclear, environment, functional facilities, mining – in all these sectors, there is extensive construction, increasing attention to investment optimisation and a need to control interaction between infrastructure and its environment. In addition, more and more building is being carried out in built-up areas. Take for example the Grand Paris projects. This type of work has major impact in terms of noise, vibrations, shifting terrain, utility network relocation, traffic management and environment. The activities and solutions Sixense offers address all these complex issues.

Do you have priorities for rollout?

Digital solutions are a core component of our offer. We have therefore set up the Sixense Digital company, in a startup spirit, to centralise our expertise and solutions in this field. We started by rolling out our tools and platforms in France, where we are well established. We will rapidly be rolling out our business internationally. Meanwhile, our subsidiaries will expand their portfolio by providing the entire Group range of solutions and services, notably in Western Europe, North America, Asia, Australia and the Middle East. We will then broaden the network by expanding into new countries.

DIGITAL SITE: THE BIM-CENTRED WORKSITE



Because 2D drawings have so far been used in most cases to monitor works, it has not been possible to manage information in three dimensions or by object. With Digital Site, Sixense has developed a collaborative tablet or smartphone based tool that supports 3D and hence the use of BIM (Building Information Modeling) in the field. This has brought about a profound change in worksite monitoring, from design to Full Completion Guarantee. In 2016, Digital Site was used on the ARCHADE project in Caen, France (see testimonial opposite). The teams also used BIM to track execution of work on the Saint Gobain high-rise in La Défense, and on smaller-scale projects such as the Emerald wastewater treatment plant in Petit-Quevilly.

Responsiveness serving productivity

Beyond the objective of "zero paperwork", the "BIM to site" system is now a reality at a time when building information modelling is prompting us to rethink the entire industrial process and the relationships between the stakeholders. Operators, architects, design engineers, builders and maintenance companies share the same database in which the structure to be built is modelled in space and described in detail at the various phases of its life cycle. By going beyond the known borders of the BIM experience, Digital Site enables works teams and QHSE personnel to carry out quality control, Full Completion Guarantee items and Defect tracking and monitoring by directly working on the model contained in their tablet. Participants can notify defects more easily and often earlier, in the design stage or even during factory quality controls. They can anticipate nonconformities and set up dynamic planning to boost productivity.

Centralised information accessible to everyone

"By avoiding double data input and using the documentary management system to ensure traceability of activities and manage the document life cycle, Digital Site generates substantial reliability gains," says Rodolphe Chabannaud, Director, Sixense Digital. "All participants have access to the same level of information, which is centrally collected in a single tool, virtually in real time." Lastly, the system automatically generates a large number of contractual documents, forms and slips, and helps produce the as-built records. It also helps to ensure consistent information sharing between the operator, general contractor, builder and investor. By making detailed analysis of the data and statistics collected available, Sixense has entered the era of big data and is already working to make this project overview, obtained in a few clicks, into an added value that can be used for many purposes, including anticipating, predicting and planning maintenance with great precision.

■ ■
We have boosted quality and reliability in information sharing
■ ■



Donatien Favreau – Sogea Nord-Ouest

Works Engineer, Sogea Nord-Ouest, lead company of the design-build-maintain consortium for the ARCHADE project (Caen, France)

"Building a hadrontherapy research and treatment centre, which uses an innovative particle acceleration technology to treat cancer, involves very exacting quality of execution and controlled production. We therefore set up a 100% BIM programme from the design phase. Because we were making full use of BIM resources, Digital Site was the construction project management tool suited to our issues: building a structure subject to severe constraints, a complex technical synthesis and flows of information involving a large number of participants. Digital Site can extract meaning from a substantial mass of data. Above all, it can manage information, unify it, circulate it and archive it. It has been exciting to watch the development of Digital Site, help improve it based on wide-ranging, constructive discussions with Sixense experts and make use of the further development potential of the already powerful tool, as part of a win-win partnership."

Thames Tideway Tunnel, East Section
London, United Kingdom



Towards environmental excellence

The Thames Tideway Tunnel in London consists of excavating 25km of tunnel and several shafts to cope with overflows of untreated sewage that currently flows into the River Thames. The Sixense team was involved early on to provide structural and environmental expertise, and an integrated monitoring service on this vast project, which is being built by a consortium comprising Costain, VINCI Construction Grands Projets and Bachy Soletanche (CVB). The works are being carried out in the heart of the capital where issues relating to local residents' sensitivities, urban density and property pressures are acute, meaning the effective management of ecological and environmental issues is crucial to the success of the project. In 2016, Sixense rolled out a unique environmental monitoring tool that integrates data from automatic sensors and manual measurements to provide real-time analysis coupled with a dynamic alarm system. The company also acts as consultant to the consortium by carrying out provisional and forecasting calculations, and approving solutions to manage risks involved in the operation, notably in terms of noise and air quality. In this project, carried out in an occupied site, community outreach is an essential part of the works scheduling and organisation process. Using the Geoscope software platform has allowed information to be shared depending on the different phases of work, and enabled better communication between the various stakeholders in the project. In a separate innovation, in partnership with CVB, Sixense is studying the implementation of a technique for detecting gaps and cavities in the annular tunnel space in order to ensure quality of injection following passage of the tunnel boring machine (TBM). This further illustrates its expertise in anticipating and monitoring the impacts of large-scale sites in complex urban environments.

Yavuz Sultan Selim Bridge
Istanbul, Turkey

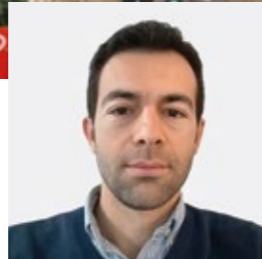


1,000
MEASUREMENT
CHANNELS

The Sixense subsidiary dedicated to infrastructure monitoring and management solutions handled monitoring operations on the third Bosphorus bridge (see page 59) and then, when construction had been completed, measured tension in the hangers and stay cables and carried out a modal analysis of the structure. The work consisted primarily of implementing a continuous monitoring system made up of more than 1,000 measurement channels with accelerometers, differential GPS sensors, inclinometers, weather met stations and temperature, humidity and displacement sensors. The sensors were installed on the support cables, stay cables, expansion joints, deck, and towers culminating at a height of 322 metres. The indicators used to monitor the structural condition of the bridge and the proper operation of the monitoring system itself are particularly innovative; they detect abnormal bridge ageing and issue alerts. The same function is performed with respect to damage due to an earthquake or breakdown in the monitoring system. Another advantage is that the combination of the EverSense® monitoring solution and Sixense's ScanPrint SHM (Structural Health Monitoring) management tool integrates the measurements and processes them simultaneously and continuously. This combination gave clients Hyundai and South Korean Engineering Construction unified structure data in the same software package and will do the same for ICE, the company operating the bridge and its toll motorway.

SNCF VGM application
France

In 2016, the Sixense teams helped us develop a modern, integrated software package to digitise our control system and optimise management, monitoring and maintenance of our platforms and buildings. Their agility and experience enabled us to set up the SNCF VGM mobile app using ScanPrint software and to implement it in under three months. The application is in the running for the SNCF Group trophies and has already won Gares & Connexions and SNCF Mobilités trophies. Today, 34,000 goods are recorded in the application's inventory and more than 200 of our agents are patrolling our stations, equipped with tablets. With this tool that has been adapted to our needs in terms of personalisation, display and notation for works, we carry out our technical inspections, safety audits and incident feedback in an efficient and documented manner. A total of 60,000 photos were taken and 2,900 inspections were carried out in 2016. The result is centralised data, more precisely targeted interventions, more efficient schedule management, optimisation of time allocated for inspections, a hierarchically organised maintenance base and therefore, ultimately, optimised costs. We are already thinking about improvements in 2017 that will enable us to integrate our structures that make up stations and to include new functionalities reflecting feedback from users.



Pelayo Villanueva
National Engineering Structure
Adviser, Gares & Connexions,
SNCF (France)

In April 2016, EDF's engineering division covering assets in operation and under deconstruction and the environment (DIPDE) asked Sixense to inspect 24 units within 10 nuclear power plants

As part of the basic civil engineering preventive maintenance plan and their fire action plan, the new five-year contract covering three sites in Normandy, three in eastern France and four in the Rhône-Alpes region, gives 35 Sixense employees dual inspection and consultancy responsibilities. Building on the successful partnership on the CPO unit in Fessenheim and Bugey that demonstrated the engagement and rigour of the operational staff, Sixense carries out periodic inspections, classifications and alert reports concerning civil engineering risks (concrete strength, waterproofing, cracks, etc.) and fire safety systems (sealing, passive protection, loss of fire sectorisation integrity, etc.). The teams are thus contributing to ensuring the first component of a broader strategy aimed at extending the life of the French nuclear fleet and ensuring its continuous improvement, at a time when the need for preventive maintenance is a focus of attention as part of the post-Fukushima nuclear safety programme now being implemented.



10 nuclear power plants
France

Línea Amarilla highway
Lima, Peru



An urban motorway with 12 viaducts and a road tunnel

In 2016, VINCI Highways acquired 100% of the LAMSAC company, the concession holder in charge of financing, building, operating and maintaining the 25km Línea Amarilla toll section of the Lima ring road until November 2049. By acquiring a project that was already more than half completed, the VINCI Concessions subsidiary was taking on a large challenge. The standard section now in operation is a thoroughfare with average traffic of 139,000 vehicles per day in 2016. Soletanche Bachy took part in the construction of a number of structures, while Sixense experts worked with the VINCI Concessions technical teams during the bidding phases in May and June 2016, and during completion of work on the section. They were charged with providing advice during the transition between the builders, with drawing up a report on the condition of the existing structures and a list of issues to be taken into account when completing the works. Based on data collected during on site assessments and reviews of project files, a maintenance plan was drawn up. It takes account of the initial condition of the asset, environmental and traffic conditions, and assumptions with respect to deterioration and associated maintenance of the structures and bridge equipment. In addition, the Sixense teams were given a specific audit assignment to assess the conformity of a part of the road tunnel on the Línea Amarilla. It was completed in November 2016 and combined the expertise needed to verify the calculation of the section's stability as it passes under the Rimac River and to analyse the risks relating to durability and maintainability throughout the concession period.



City Rail Link
Auckland,
New Zealand

15
ROBOTISED STATIONS

In Auckland, Sixense is working on the City Rail Link (CRL) new underground rail line. The project, which consists in building two rail tunnels and connecting them to existing tracks, is being carried out under and around one of the city's large stations, the Britomart Transport Centre. As part of this project, Sixense handled the infrastructure monitoring network primarily composed of 15 robotised Total Stations using laser measurement and more than 1,000 measuring points to monitor buildings and pavement deformation around the sites. The team is also using piezometers, inclinometers and stress gauges to track the movement of the retaining walls and anchors during excavation works. This real-time monitoring is made possible thanks to the digital platform, Geoscope, and its capability to trigger alarms. Sixense is carrying it out to ensure site safety and reassure local residents.