Maintenance of 630 rail stations: from underground utilities survey to Civil 3D and GIS

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Agenda

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About us

FSTechnology and the Competence Center BIM GIS
FS Technology is the hi-tech company of the FS Italiane Group. The mission of FS Technology is to strengthen and support digital innovation in group companies, and ensure top levels of quality, efficiency and time to market in customer services. Special attention is paid to the optimisation of predictive diagnostics in industrial processes that involve the adoption of new technologies such as blockchains, Artificial Intelligence, robotics and the IoT and to the centralised management and standardisation of processes and tools.
The Competence Center BIM GIS

The Competence Center BIM GIS is a team inside FSTechnology. The main objective of our team is the research of new technologies to improve the processes and the workflows for the entire lifecycle management of an infrastructure. Considering the core processes of the group, we mainly support linear infrastructure project.
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The project

The project of Water management inside the Ferrovie dello Stato Italiane Group has started at the end of 2018 and consists of bringing up to standard and subsequently maintenance of the utilities and equipment of several rail sites in Italy.

This activity will take 10 years to the end.
Description

The sites

- 28 Great Stations (> 150,000 mq)
- 54 Medium Stations (>100,000 mq and <150,000 mq)
- 548 Little Stations and Stops (<100,000 mq)
- 20 Electrical Substations
- Several logistic facility sites
For all sites the activity consists of bringing up to standard utilities and equipment which means:

- Identification of water supply systems, sewer systems, water treatment plant, washing systems for rolling stock;
- Retrieval of existent data and design of a different systems network and fire systems to bring up to standard;
- Improvement of water metering and leak detection systems;
- Bring up to standard and monitoring of transformer trays of the electrical substations;
- Check of the agreements with local providers;
- Smart card – automatic systems for the water consumption.
Description

- Build up a GIS platform connected to SAP system to manage the maintenance of all assets:
  - Water supply and sewer systems;
  - Water treatment plants;
  - Washing system for rolling stock;
  - Sanitizing devices;
  - Monitoring and control of water cost;
- Quality and environmental monitoring with periodical surveys.
Organization

- **Italferr**: Responsible for the Project
- **FS Technology**: Consultancy for Innovating workflows
- **CNR-ISPC**: Consultancy for Innovating methods of analysis/monitoring
- **Rete Ferroviaria Italiana**: Owner

Support flows among the organizations.
Rete Ferroviaria Italiana is the company of the Ferrovie dello Stato Italiane Group is the owner of entire railway infrastructure, water supplied systems, water treatment plants, well, spring, etc. It is responsible for management and for safety of the rail traffic on the whole national network, track, stations and installations.
Italferr is the engineering company of the Ferrovie dello Stato Italiane Group. Italferr has as mission to preserve and protect the environment by making sure that their projects conform to the applicable European regulations and to sustainable development strategies. To this end we develop ad hoc studies to assess the impact of our projects on the environment and the surrounding landscape, and, in general, to evaluate the direct and indirect effects of the infrastructure construction works.
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The National Research Council (CNR) is the largest public research institution in Italy. Founded as legal person on 18 November 1923, CNR’s mission is to perform research in its own Institutes, to promote innovation and competitiveness of the national industrial system, to promote the internationalization of the national research system, to provide technologies and solutions to emerging public and private needs, to advice Government and other public bodies, and to contribute to the qualification of human resources.

ISPC is the department inside CNR that combines the so-called "hard sciences" with the "human sciences", with the construction and refinement of a common language in research applied to cultural heritage. Therefore the Institute defines, implements and optimizes new methodologies and technologies of investigation to study the territory and its historical artifacts.

The new methods and technologies in the field of applied geophysics and the analysis/monitoring are intended to create a new knowledge, enhance and enjoy cultural, archaeological and architectural heritage in Italy and abroad.
The Team

Salvatore Piro
Research Director - Geophysicist

Enrico Papale
Researcher

Marcella Faraone
Head of Competence Center BIM GIS

Stefano Libianchi
BIM Specialist

Alessandro Delle Monache
Technology specialist

Ilaria Mascellani
Senior GIS Analyst

Sara Padulosi
Head of Water Management Team

Antonio Varricchio
Technical Coordinator: Environmental and Drainage

Simone Martelloni
Technical Coordinator: Civil works and Idraulic

Research Director - Geophysicist

Head of Water Management Team
During the first phase of the project (still ongoing), we’ve been supporting Italferr in the digitalization of the first 50 sites (including stations and electrical substations). During this first phase of the design, the workflow followed is listed below:

- Asset identification and topographic survey;
- Drainage network reconstruction with Autodesk AutoCAD:
  - Bath and water services survey
  - Descendants survey
  - Survey of external confluence shafts
  - Networks shaft survey with tracers and video inspections
- Survey of connection of the drainage network to the public sewer
Traditional design workflow

- Verification of the data collected via the Excel spreadsheet
- Design new networks (AutoCAD and Excel)
Traditional design workflow

- Import of the network from AutoCAD to Esri Web GIS platform through shape files
- Integration of the information in the GIS Database through Excel files
Workflow optimization

01 Geophysical survey
With the use of a Georadar

02 Digitalization of the network model
Civil 3D and Storm and Sanitary Analysis

03 Import of all data in GIS Platform
Esri ArcGIS Pro Network Utility and Civil 3D

04 Connection with ERP system
Esri ArcGIS Pro and SAP

Use of BIM 360 as a common data environment
Geophysical survey

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Geophysical survey

Problems with Traditional Survey:

- Manhole covered and not viewable;
- Complexity of reconstruction areas that are difficult to understand;
- Impossibility of identifying impediments in the underground;
- Impossibility of detecting water leakage along the networks;
- Inability to identify voids or cavities that could be dangerous for the subsequent activity.
Geophysical survey

The best geophysical method to survey the utility is G.P.R. - Ground Penetrating Radar:

- The radar signal is an electromagnetic pulse that is directed into the ground;
- When the pulse meets an object, the waves are reflected identifying the shape of its;
- The travel time of pulse indicates the depth of the object.
Geophysical survey

The ground penetrating radar (G.P.R.) method is useful:

- to have an accurate knowledge of the underground utilities;
- to prevent potential danger for the people or the interruption of services;
- to work in compliance with the design phase;
- to avoid wrong estimates of costs;
Geophysical survey

The Prenestina electrical substation in Rome

Area to be surveyed
Geophysical survey

Data processing

Processing data acquired in the field → this procedure is done by optimization of signal recorded through different types of the filters and amplifications.

Interpretation

We used software specialist of interpretation to find out the dept of underground utility. The results are transferred automatically to CAD/GIS softwares.
Geophysical survey
Geophysical survey

Data processing

Slice n. 1
Dept 100 cm

Slice n. 2
Dept 70 cm

Slice n. 3
Dept 50 cm

Slice n. 4
Dept 20 cm
Geophysical survey

Results interpretation

Slice n. 1
Dept 100 cm

Slice n. 2
Dept 70 cm

Slice n. 3
Dept 50 cm

Slice n. 4
Dept 20 cm

Manholes
Geophysical survey

Results interpretation

Slice n. 1
Dept 100 cm

Slice n. 2
Dept 70 cm

Slice n. 3
Dept 50 cm

Slice n. 4
Dept 20 cm

Pipes
Geophysical survey

Results interpretation

Slice n. 1
Dept 100 cm

Slice n. 2
Dept 70 cm

Slice n. 3
Dept 50 cm

Slice n. 4
Dept 20 cm

Old binary
Digitalization of the network model

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Digitalization of the network model

The digital elevation model exported from Infraworks
Digitalization of the network model

Modelling the Network with Civil 3D
Digitalization of the network model

Comparison of the results

Traditional Survey
Georadar Survey
Digitalization of the network model

Modelling the Network with Civil 3D
Digitalization of the network model

Modelling the Network with Civil 3D
Digitalization of the network model

Modelling the Network with Civil 3D

Traditional Survey
Georadar Survey
Digitalization of the network model

Modelling the Network with Civil 3D
Digitalization of the network model

Modelling the Network with Civil 3D
Digitalization of the network model

Comparison of the results with BIM 360
Digitalization of the network model

Storm and sanitary analysis
BIM and GIS integration

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The interoperability between Civil 3D and ArcGIS Pro, allow us to recreate the entire network, designed within Civil 3D, inside the Network Utility tool with all attributes and elements of a networks of slope pipes or pressure pipes.
Importing data in GIS platform
Connection with ERP system

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   Esri ArcGIS Pro and SAP
Connection with ERP system: to do

Integration with SAP module for the maintenance

- More effective economic management of the network
- Integration management of the water network
Effective maintenance

**Mobile App**
- to archive field data collection
- network management
- field verification with the survey app

Field survey:
- Mobile app
- Augmented reality
Effective Facility Management
Conclusions

This activity will take 10 years to the end and will allow the group to:

• save several millions of euro

• from sustainability point of view, consistent water saving thanks to leak detection systems;

• an effective maintenance.
Wrap up

Brief description of the project and the traditional method

Introduction of the new workflow and new technologies with geophysical survey of the underground utilities and BIM and GIS integration

The future with the connection with SAP and the maintenance of all sites
Thank you

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