ARCHITA

Innovative multidimensional mobile mapping system

Italy

Presented by : Ricardo Ferraro, Head of Survey Department ETS S.r.l.

ARCHITA
ETS MOBILE MAPPING SYSTEM

ARCHITA
ETS MOBILE MAPPING SYSTEM

Miami, USA 18th November 2019

Ricardo Ferraro, Head of Survey Department

ARCHITA
ETS MOBILE MAPPING SYSTEM

Miami, USA 18th November 2019

Ricardo Ferraro, Head of Survey Department

CHALLENGE

ensuring sustainable transport, safety and security
by improving the infrastructure management system

ARCHITA

is a multidimensional mobile mapping system with linked and integrated equipment of survey and position sensor installed on a vehicle. A large set of information (geometry, status, structural condition) are obtained in a single passage and integrated in one output environment for the maintenance, design and the management of infrastructure

Ricardo Ferraro, Head of Survey Department

Benefits

ARCHITA guarantees a simultaneous and integrated survey of geometry and condition of infrastructure, gathering all the information required for the assessment, the maintenance and the management of infrastructure (all-in-one solution)

We can design the future infrastructure management through time with a clear, objective and repeatable system which supports the engineering judgement

reliable digital data

Benefits

ARCHITA guarantees acquisition velocity of 15-30 km/h on average with minimal impact on rail/road traffic, reducing the time on the in-situ activities and increasing the safety for men at work and users

ARCHITA allows to know the as-built of the infrastructure and plan the mitigation measures for the non-compliances

ARCHITA allows to check the consistency of the construction works with respect to the design

reliable digital data

increase safety and security
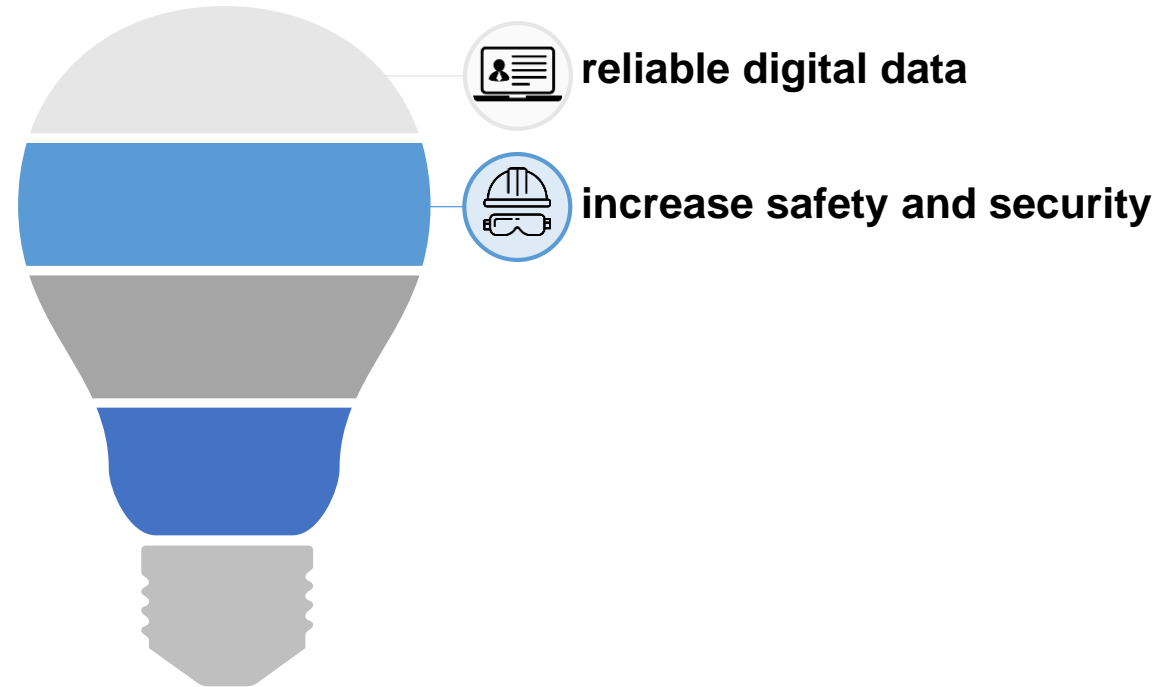
Benefits

ARCHITA produces back-office optimization and cost efficiency. Short disruption for railway and reduced traffic jam for roads (on-field activity reduced of 60%) and guarantees of reduced costs compared to standard solution with equivalent output

Reduced time for decision-making phase of the clients to plan activities and carry out cost analysis, focusing on the most critical and strategic line (small scale). Fast and reliable output to support design solutions and works strategy (large scale)
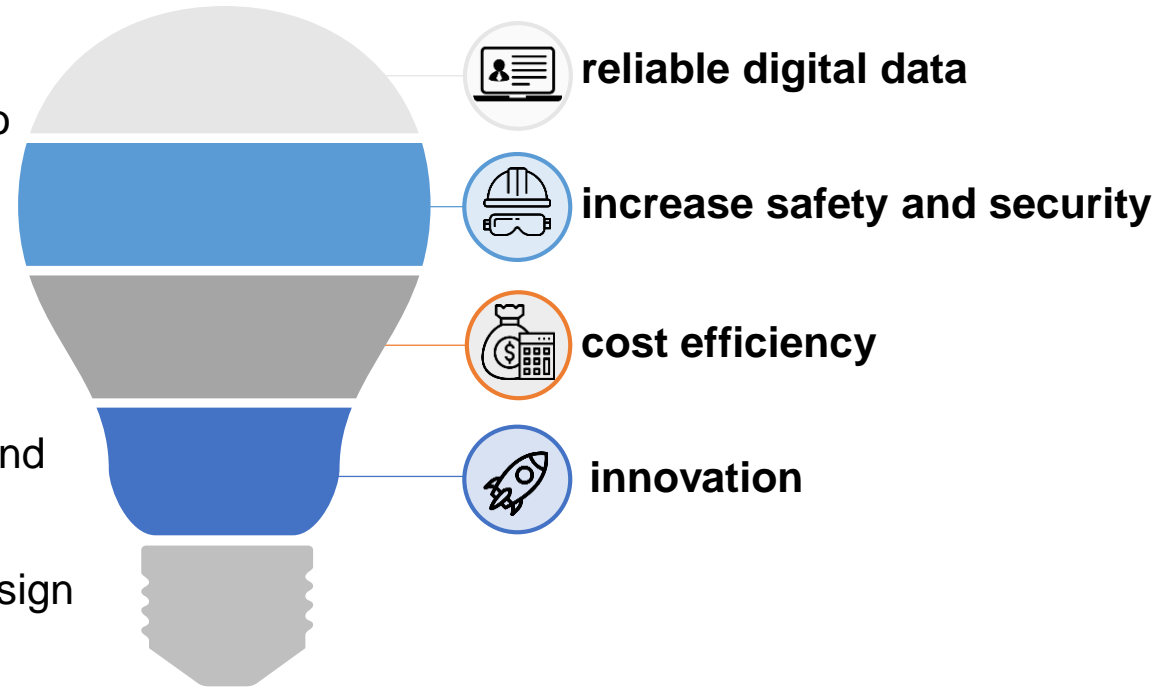
reliable digital data

increase safety and security

cost efficiency
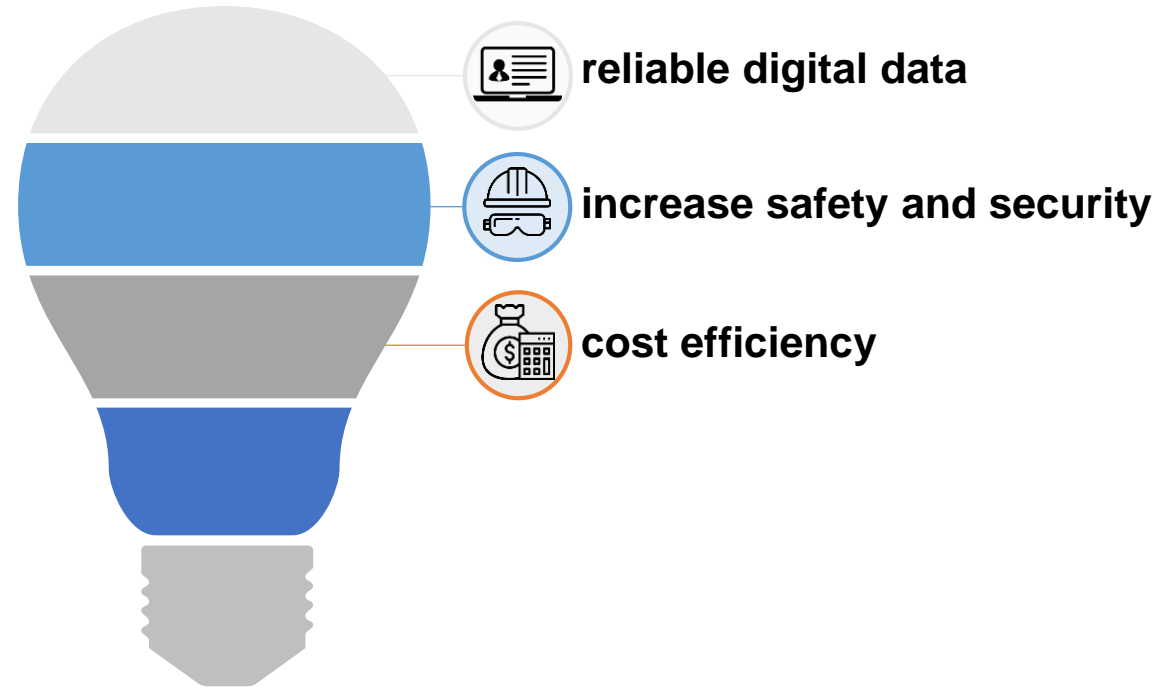
Benefits

ARCHITA consists of several technical equipment integrated into a single vehicle. This makes available an integrated DB useful to create an innovative IT environment for infrastructure maintenance, design and management.

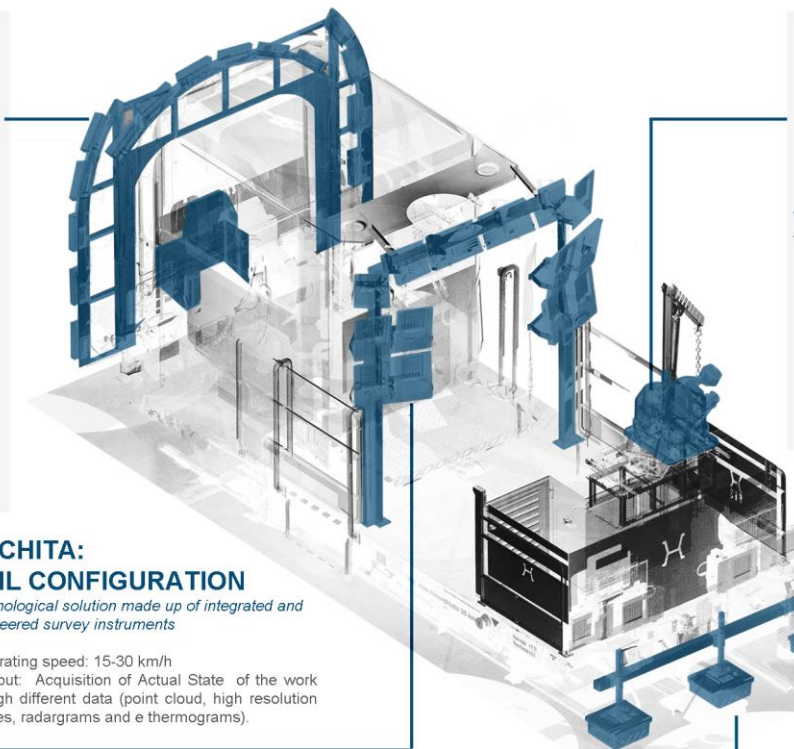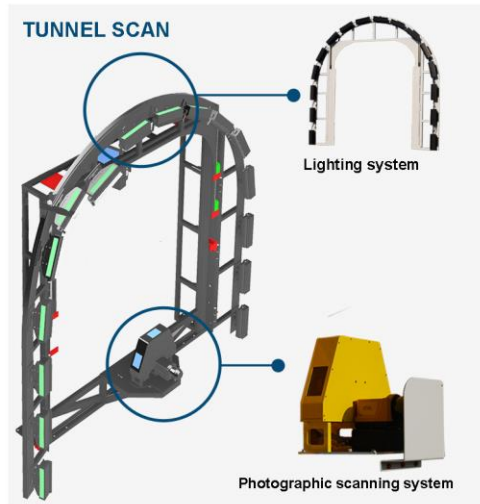Defects mapping with IA support and virtual inspection of the tunnel.

New workflow for infrastructure design from set of digital data acquired.

Innovative approach for infrastructure management through a set of objective and reliable digital data.
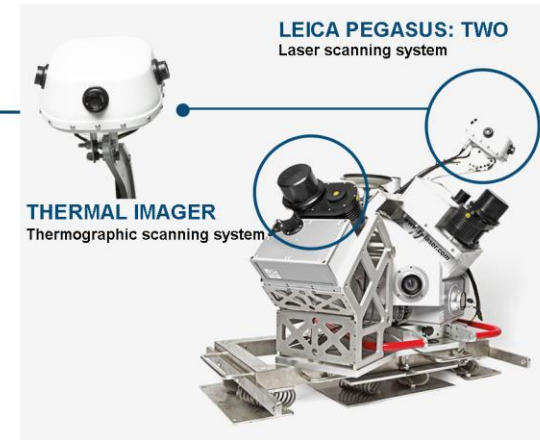
reliable digital data

increase safety and security

cost efficiency

innovation

Miami, USA 18th November 2019

Ricardo Ferraro, Head of Survey Department

Laser scanner, thermal and digital cameras,
Innovative Light solution

SURVEY SENSORS
No. 8 digital cameras with 2046 x 2046 resolution
No. 2 profilers Z+F 9012 in class 1 (2 mln p.p.s.)
No. 4 thermal imaging cameras

POSITIONING SENSORS
No. 2 GPS antennas
No. 1 IMU inertial platform
No. 1 optical odometer

Laser scanner, linear cameras,
LED light system
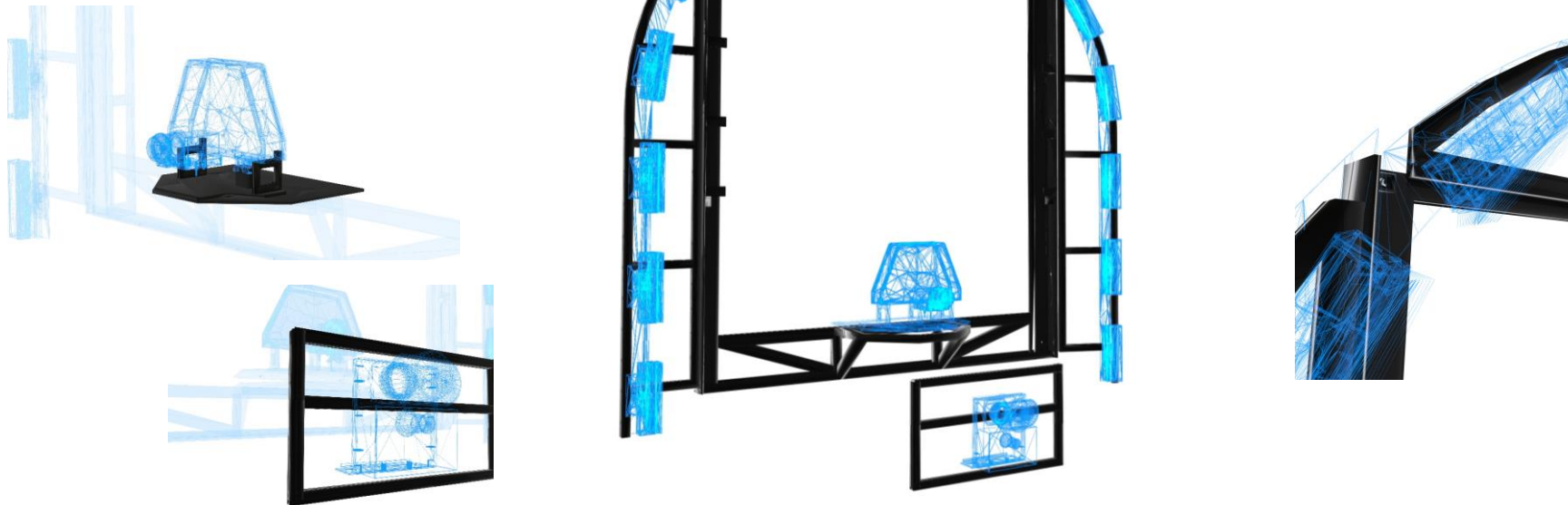
SURVEY SENSORS
No. 3 hight speed linear cameras, 18432 pixel
No. 1 profiler Z+F 9012 in class 1 (1 million p.p.s.)
No. 16 LED lighting system on steel structure

POSITIONING SENSORS
No. 1 GPS antenna
No. 1 IMU inertial platform
No. 1 rotary encoder

Ballast, lining and pavement georadars

SRS – SAFE RAIL SYSTEM	STREAM	RIS HI PAVE
n. 3 antennas of 400 MHz	n. 1 antenna of 600 MHz	No. 1 antenna of 2 GHz cupled with No. 1 antenna of 400/900 MHz
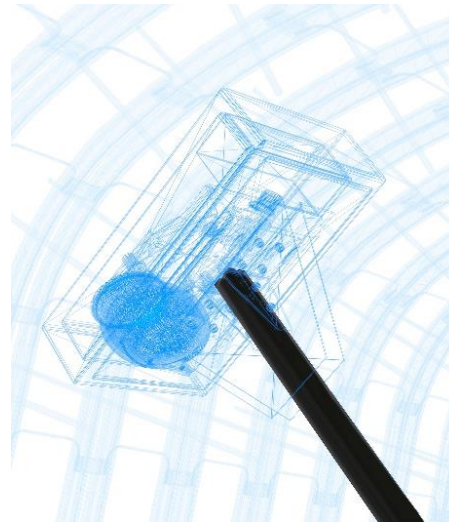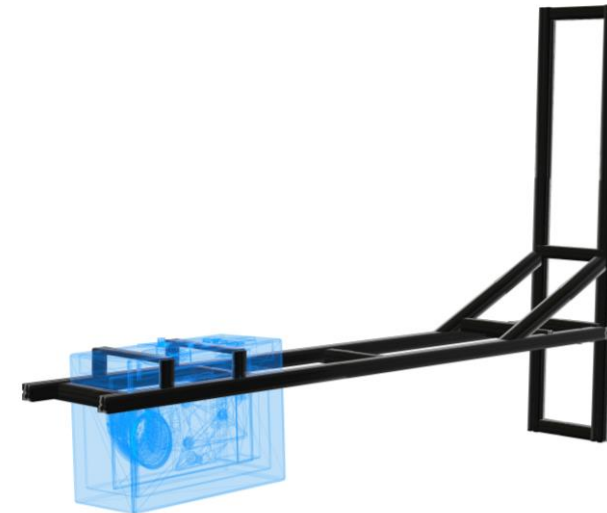
Ricardo Ferraro, Head of Survey Department

ARCHITA - equipment integration
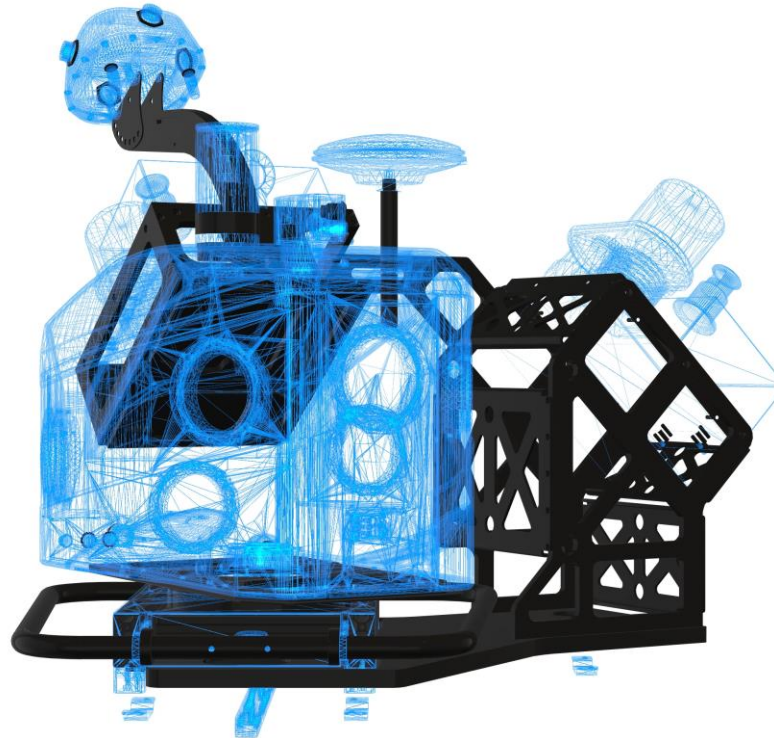
Geometric survey as a drawing start

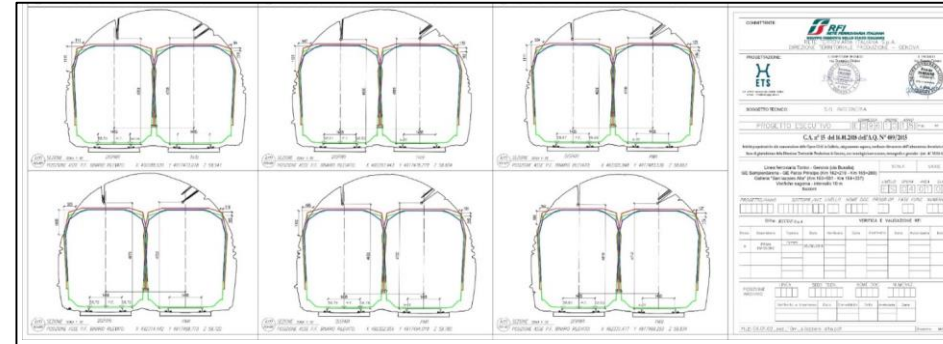Point cloud to 3D CAD model
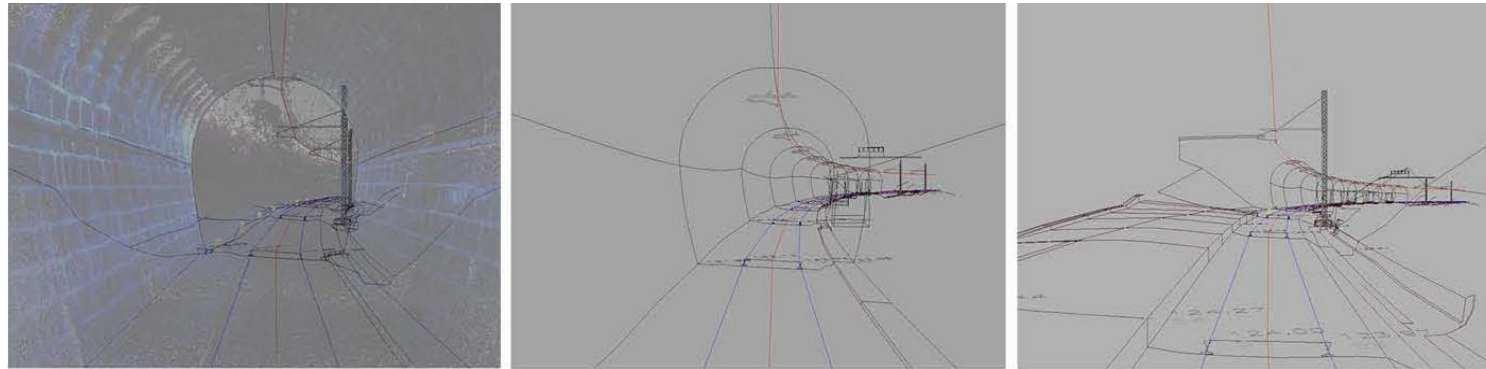
Point cloud to surface model

Ricardo Ferraro, Head of Survey Department
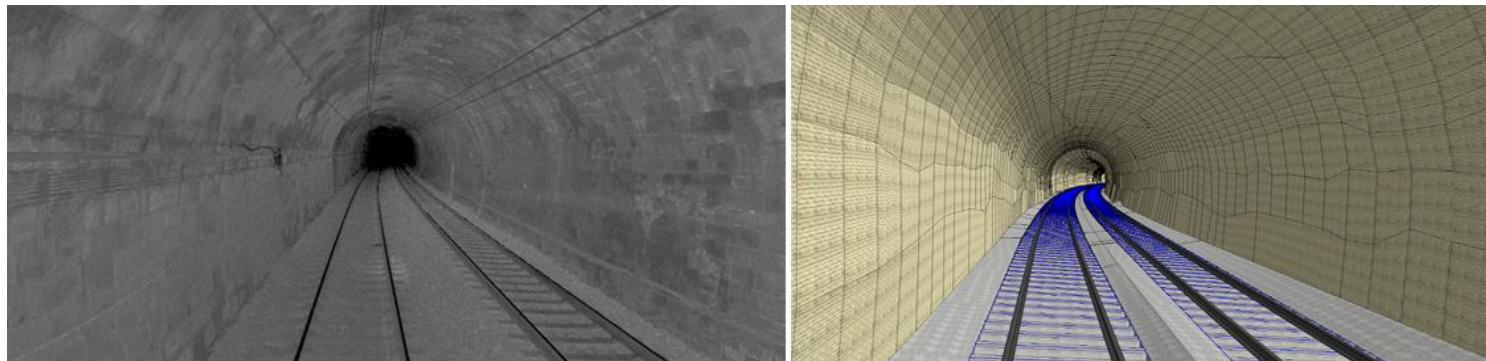
Automatic rail extraction and clearance analysis

Ricardo Ferraro, Head of Survey Department
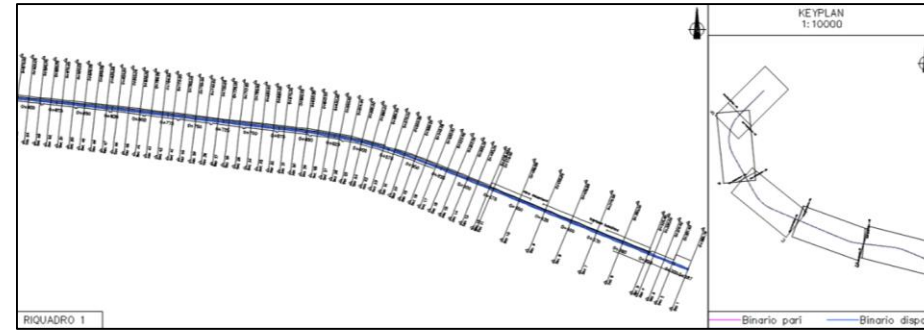
Non-destructive testing

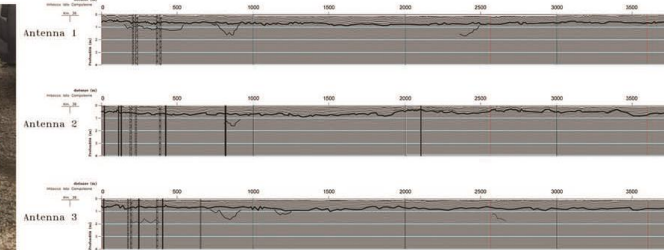georadar scanning to determine the ballast thickness, the geotechnical context and possible presence of cavities

georadar scanning to determinate the lining thickness, the additional layers beyond the lining and water phenomena
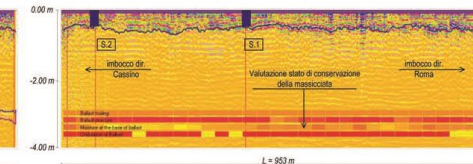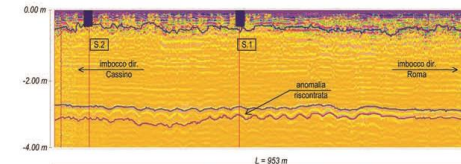

Georadar antennas

Georadar ballast scanning

Legend

Moisture
- No ballast
- Dry
- Humid
- Humid to wet
- Wet

Fouling
- No ballast
- Clean
- Mostly clean
- Slightly fouled
- Fouled

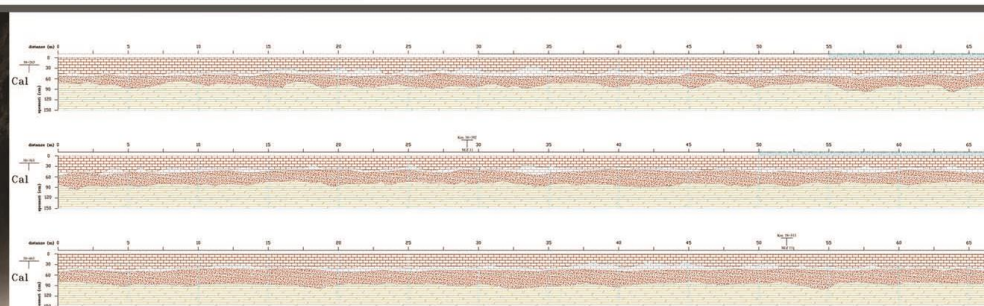Ondulation
- No ballast
- Even
- Undulated
- Settlement

Antenna No. 1

Antenna No. 2

Ricardo Ferraro, Head of Survey Department
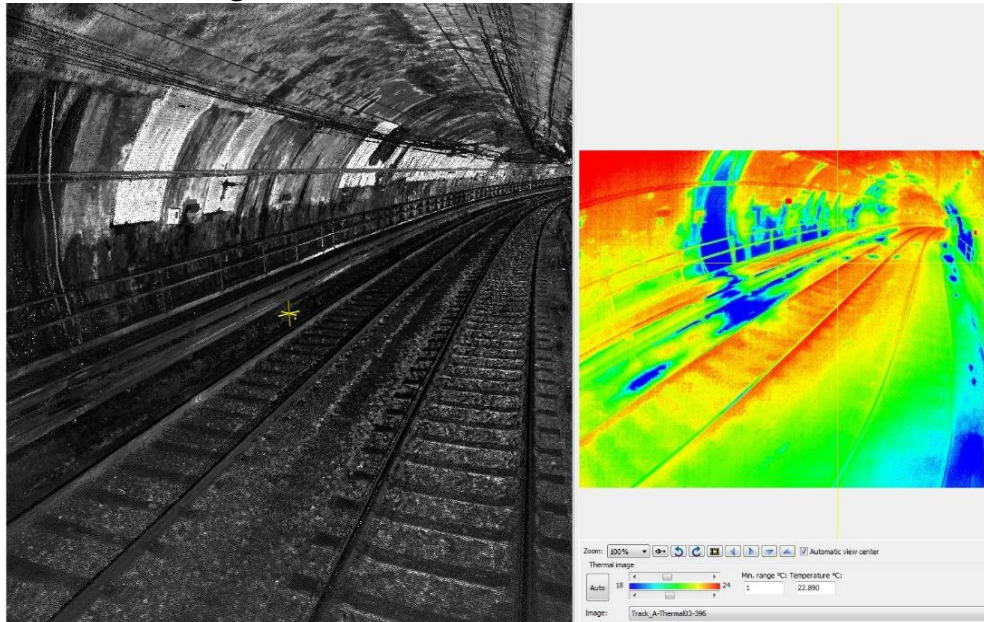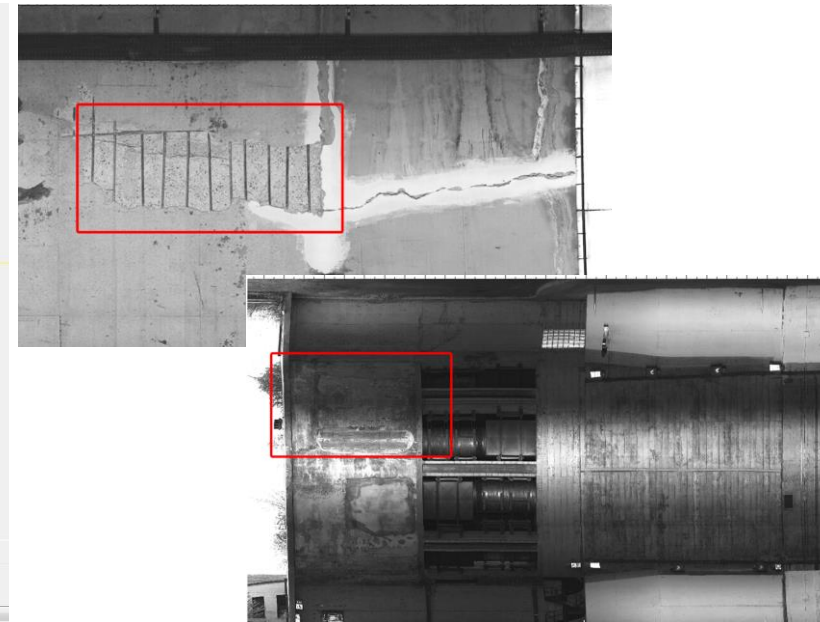
Evidence of defects detection

point cloud synchronization with thermal images

HD image from linear camera

Today we can do semi-automatic detection simultaneously with the first AI applications
Tomorrow we will achieve them thanks to the support of AI
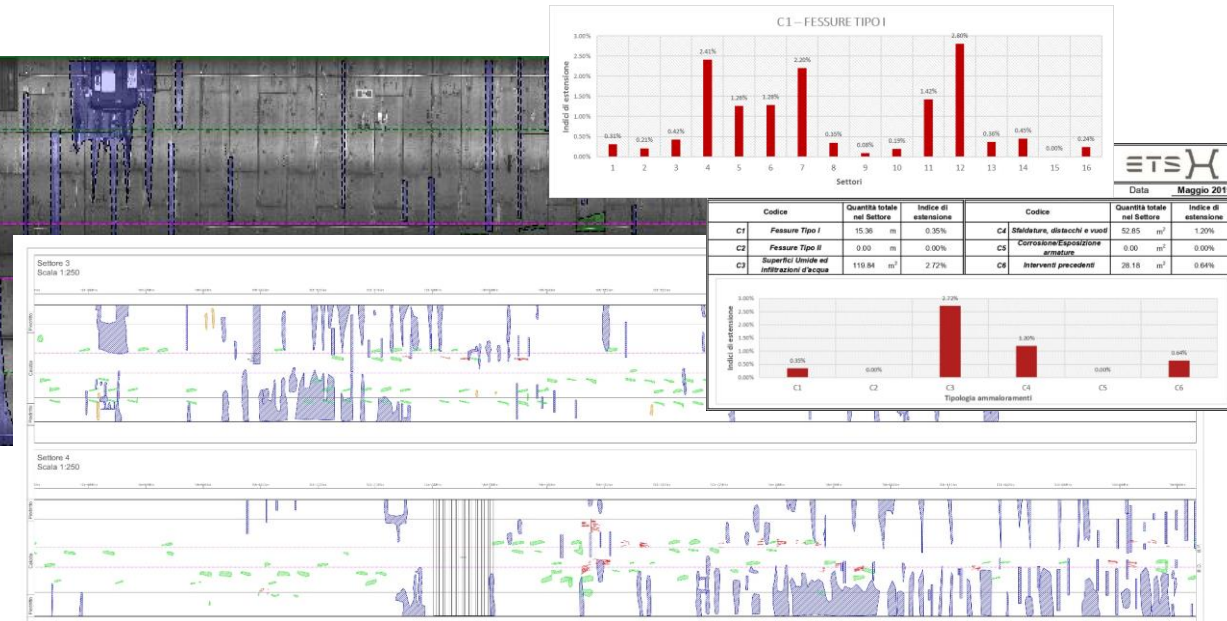
Result of defects detection

We are able to represent the tunnel current state in different ways as:
- technical drawings and reports
- defect extension index
- Virtual Reality inspection.

All data allow to undertake engineering studies to plan maintenance activities and carry out statistical studies to assess and manage the risk along the line.
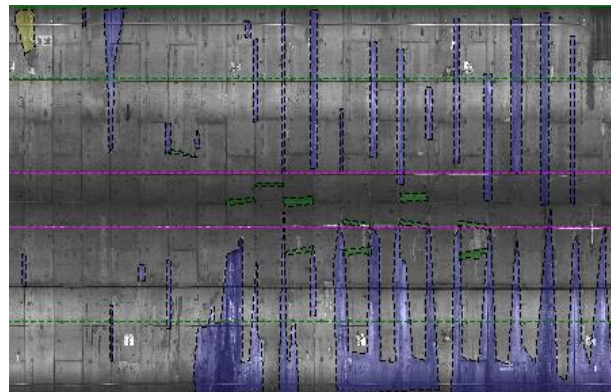

HD Image defects detection

CAD defects detection

Retro BIM

A structured workflow allows to enhance all the integrated information from **ARCHITA** survey to obtaining all the necessary output:

- Set of data obtained from ARCHITA and destructive investigations
- Diagnostic analysis to know the conservation status of the structures
- Digitalization of the tunnel geometries (modelling of railway tracks, tunnel lining, progressive sections, etc.)
- Current State Analysis and automatic clearance analysis for shape adjustment
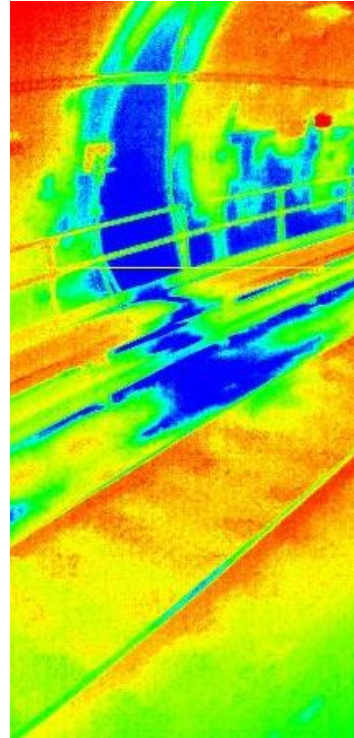- Geotechnical and structural analysis employing the surfaces and the solids from the digitalized model
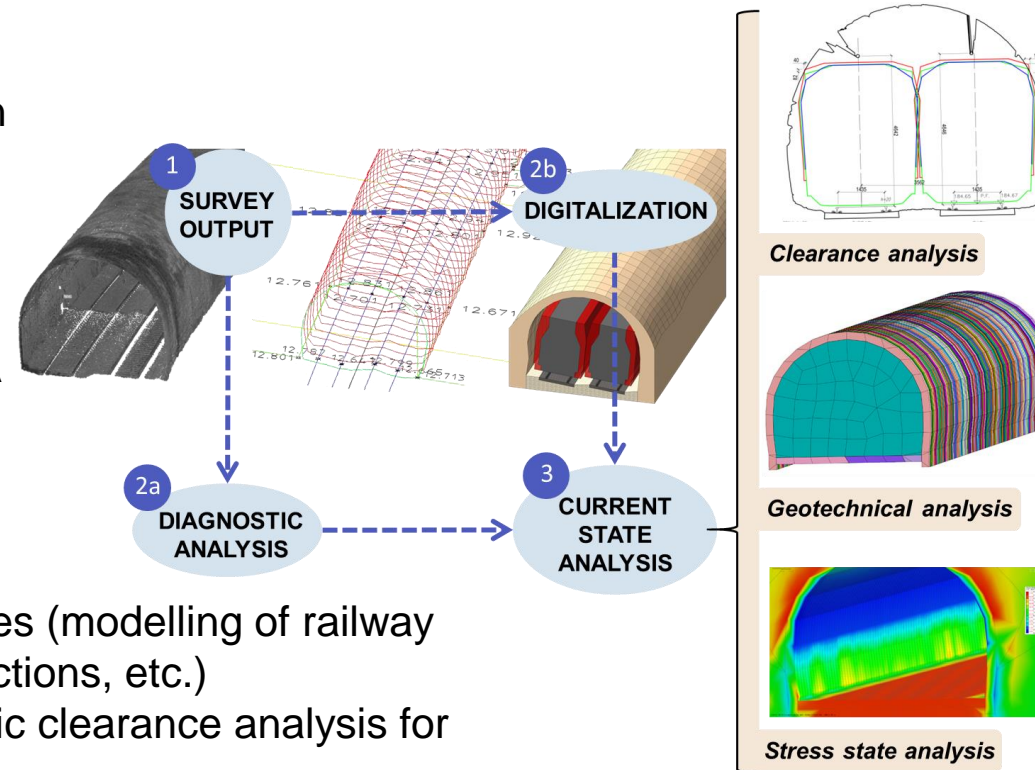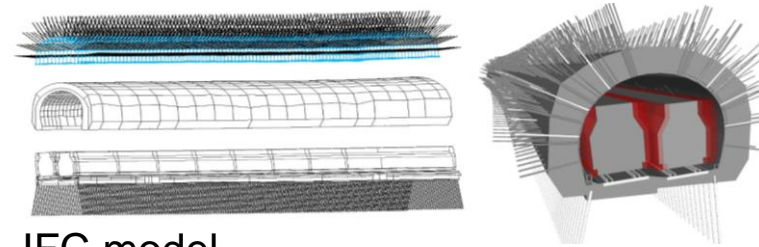
ARCHITA - Outputs integration

IFC model

3D CAD model

point cloud   thermal image   HD image   Ballast/ tunnel lining radar scanning
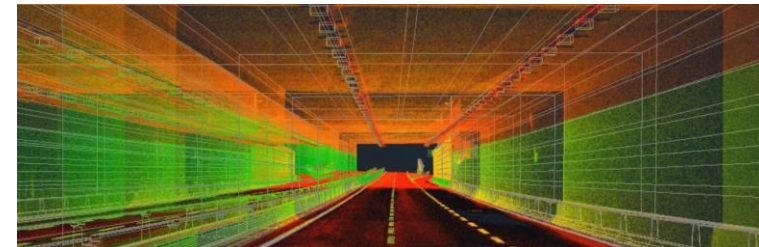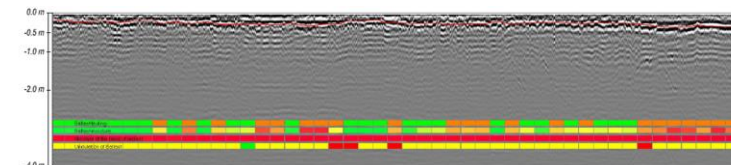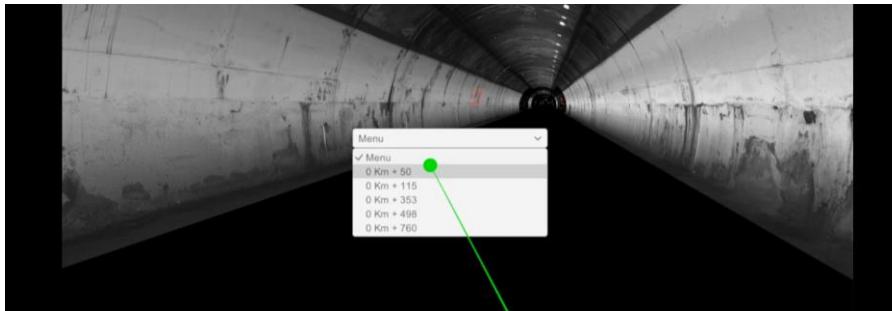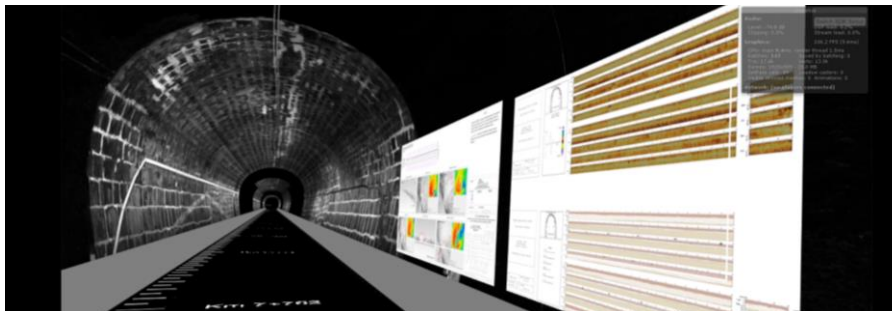
Virtual Reality Inspection

The VR inspection is aimed to verify the current state of the tunnel and allows to obtain objective geometric data and visual information for all the parties.

The VR inspection is also aimed as an innovative approach for the infrastructure management by verifying the survey results of the investigation phase and the construction work performed by all the parties.

Machine Learning

The defects mapping, the management of big data and the predictive maintenance require the implementation of machine learning to support the engineering of the future.
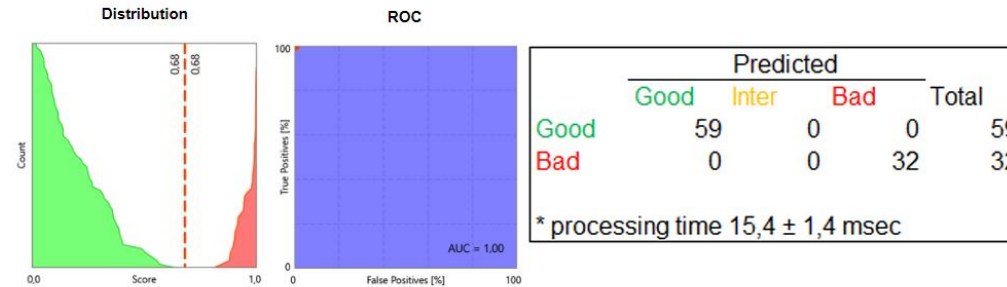
Our R&D department is involved in the development of Artificial Intelligence for these applications. Moreover, our large database and the accuracy of the instrumentation allow a proper "feeding" of the system.

An example of first machine learning test results.

Training set views
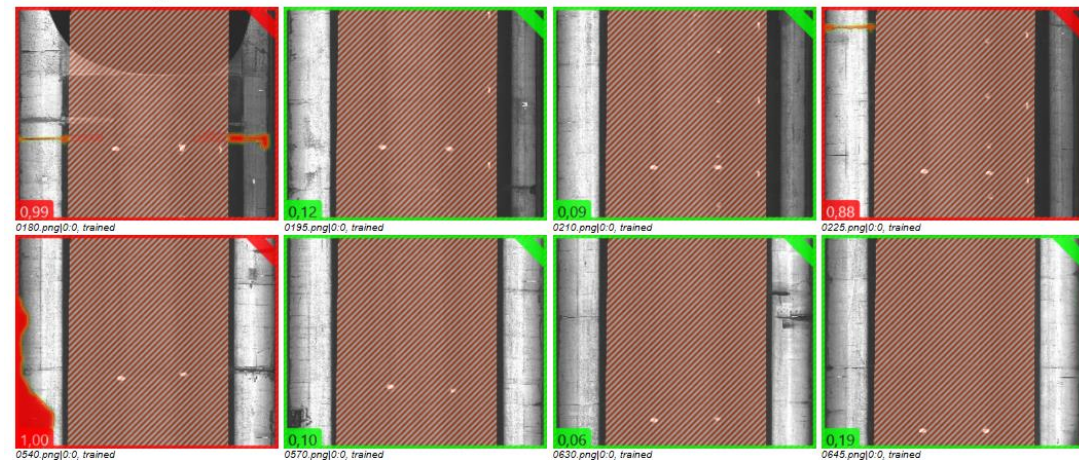
ARCHITA

Companies' Stakeholder

Contractors: Micos SpA (Costruction Company), Sveco SpA (Costruction Company), ITALFERR SpA (Italian Design Infrastructure Company), Roma Metropolitane srl (Rome Underground Design Company), FS International (Italian Railways Group)

Owners: RFI SpA (National Railways Authority), ANAS SpA (National Road Authority), Autostrada Brescia Verona Vicenza Padova SpA (Highway Authority)

Suppliers: Leica Geosystems HEXAGON Group (Manufacturer), ADTS srl (Manufacturer)

Research Institute: Bruno Kessler Fondation

International Conference: «Smart Underground Space & Infrastructures» SUS 2019, WTC2020 (coming 2020)

Thank you