Session1.5 Room Karam1
Digitalization / Engineering

Moderator : Mr. Christian Chavanel
Director of the Rail System Department,
UIC, France

ONCF UIC

Session1.5 Digitalization / Engineering Speaker Lists;

1	2	3	4	5
				
Mr.Florian Einböck	Ms.IMANE KHALLOUKI	Ms.Isabella Selmi	Mr.JIN Chenkun	Ahmet Bozat
Austria	Morocco	Italy	China	Turkey

UIC HIGHSPEED Morocco 2023

HIGH-SPEED RAIL : THE RIGHT SPEED FOR OUR PLANET

Under the High Patronage of his Majesty King Mohammed VI

11TH WORLD CONGRESS OF HIGH-SPEED RAIL

Marrakech, 7-10 MARCH 2023

TOWARDS A DIGITAL FUTURE WITH FRAUSCHER CONNECT

Florian Einböck
Product Manager, Frauscher Sensortechnik, Austria
Railway Systems | Signalling
Session5-1.5 Digitalization / Engineering

FRAUSCHER ONCF UIC

Frauscher Solutions & Services

Axle Counters

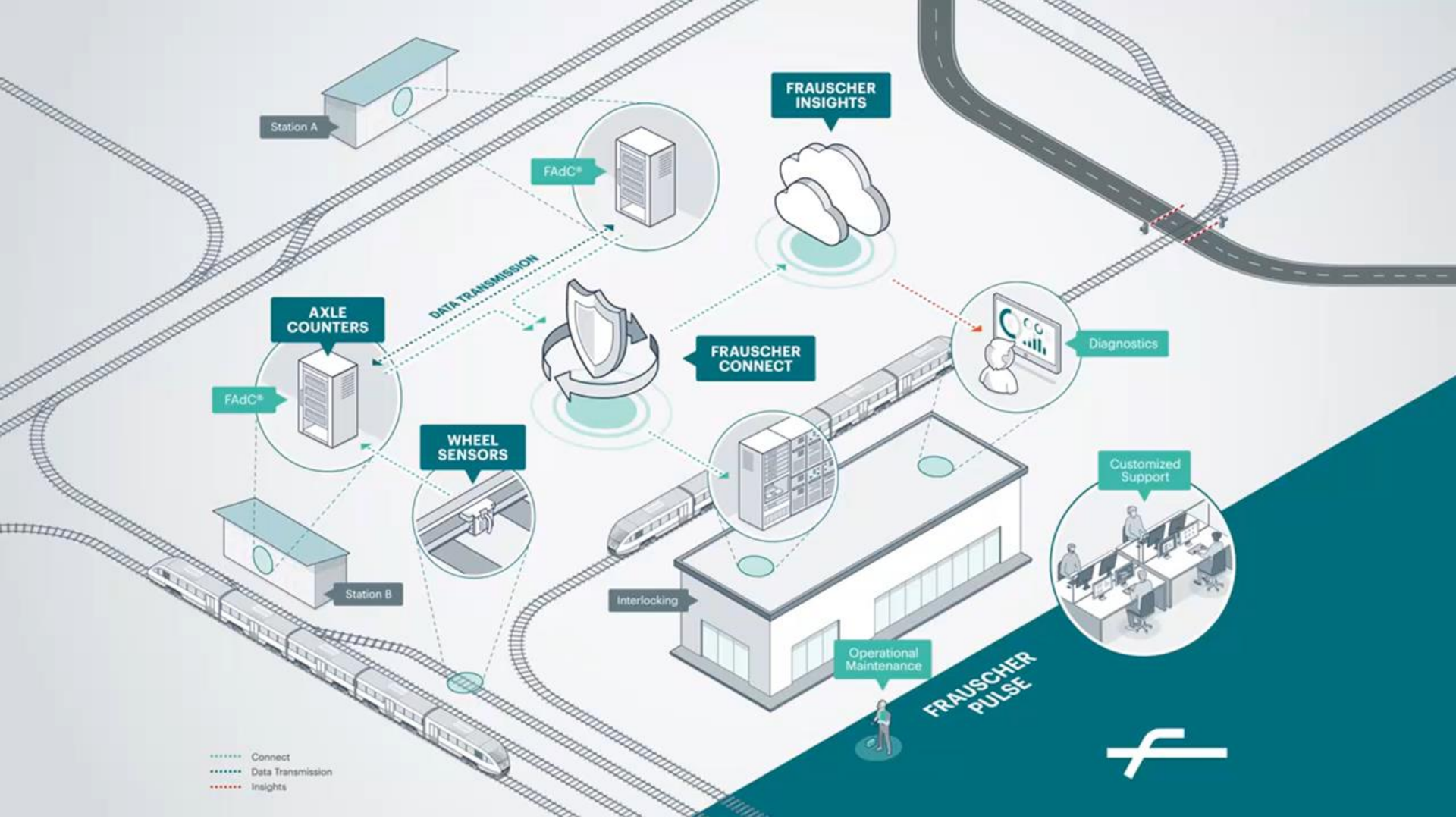
Data Transmission

Frauscher Connect

Wheel Sensors

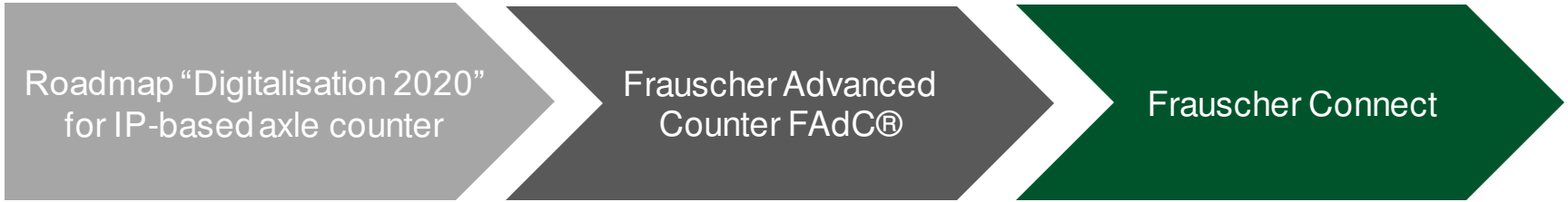
Frauscher Insights

Frauscher Pulse

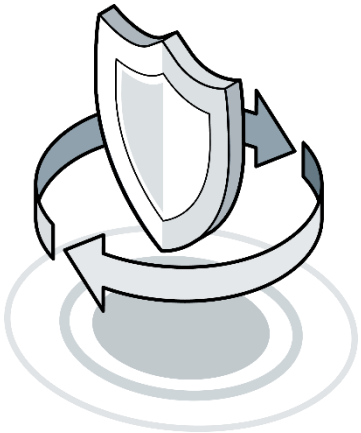

Station A
FAdC®
FRAUSCHER INSIGHTS
DATA TRANSMISSION
AXLE COUNTERS
FAdC®
FRAUSCHER CONNECT
Diagnostics
WHEEL SENSORS
Customized Support
Station B
Interlocking
Operational Maintenance
FRAUSCHER PULSE
Connect
Data Transmission
Insights

DIGITISATION OF RAILWAY OPERATIONS

- Advancing of digital railway operation
- Enabling scalable business models
- Introduction of new digital services and solutions in the following



FRAUSCHER CONNECT



- Common communication interface as driver of digitisation
- Meets requirements in both safety and security
- Enables to build up infrastructure for the usage of digital products
- New, modern CCS architecture and standards as preconditions

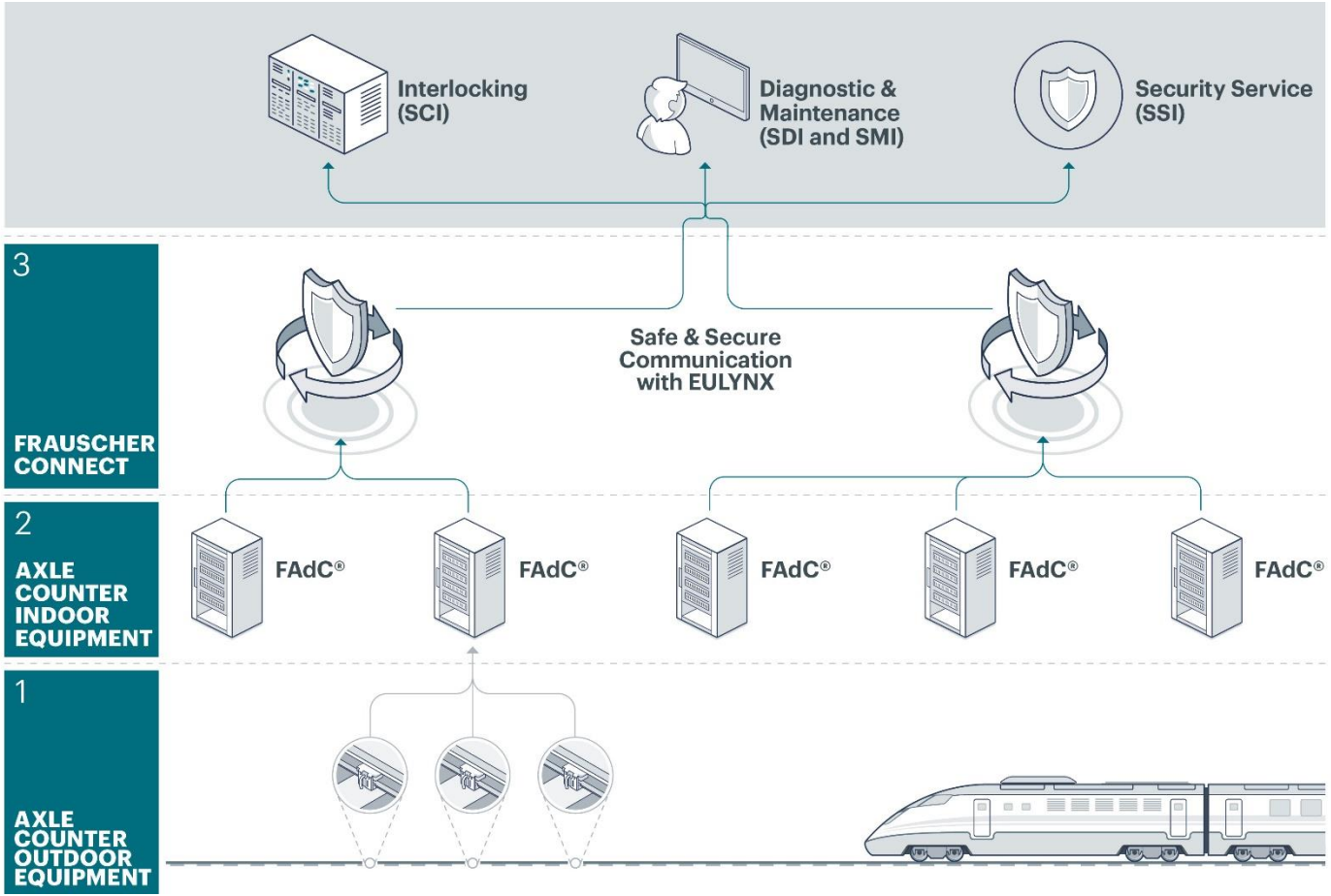
EULYNX

- Standardised interface
- Cyber security concept
- Test & Certification Management
- Distributed architecture

- FAdC® takes responsibility for maintaining security measures and update capability

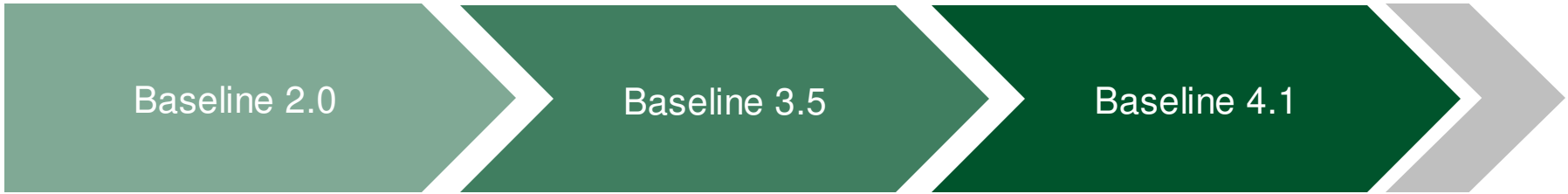
Frauscher Advanced Counter FAdC®

EULYNX ARCHITECTURE



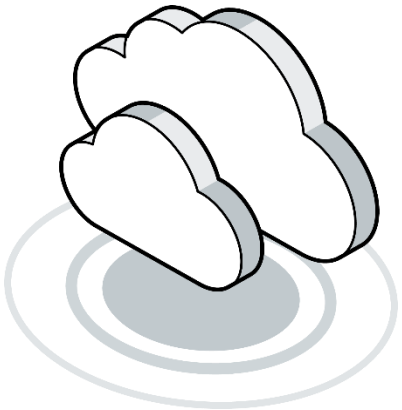
EULYNX PROJECTS

First EULYNX implementations by Frauscher:



Austria: GKB Graz-Köflach **Germany:** Zwieseler Spinne **France:** SNCF

TOWARDS A DIGITAL FUTURE



- EULYNX enables new data-driven business models
- Provision of new services possible
- Optimisation of ongoing railway operations
- Enablement of predictive maintenance

THANK YOU

FRAUSCHER

Florian Einböck
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USING IMAGERY DATA, LIDAR AND AI FOR A SMART RAILWAY TERRITORY

IMANE, KHALLOUKI
IT Project manager, ONCF ,MOROCCO
Session5-1.5 Digitalization / Engineering

ONCF UIC

IMAGERY DATA

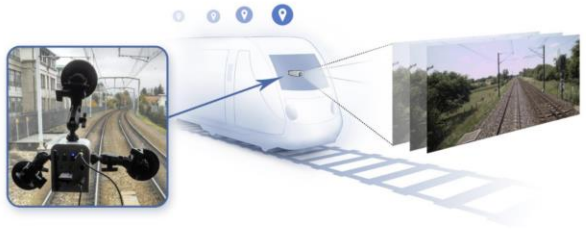
Aerial photography
(Drones or planes)

Satellite imagery

Street level imagery
(camera 360°)

Examples of applications :

- ✓ Identify potential routes for new rail lines
- ✓ Assess the condition of existing infrastructure
- ✓ Monitor land use changes
- ✓ Provide detailed views of specific areas
- ✓ Create virtual tours



LIDAR DATA

- Type of data collected using lidar (Light Detection and Ranging) sensors in the form of point clouds
- Large sets of 3D coordinates
- Used to create detailed digital elevation models (DEMs) and 3D models of the terrain

Examples of applications :

- ✓ Calculating MAS (maximum allowable speed)
- ✓ Identifying right-of-way encroachment
- ✓ Analyzing track and roadbed conditions
- ✓ Analyzing right-of-way condition
- ✓ Planning new routes & improving facilities
- ✓ Maintenance and operation

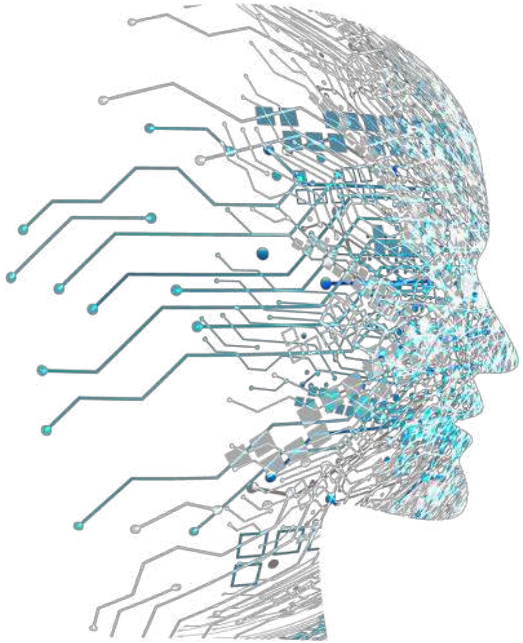
Examples of LiDAR products :

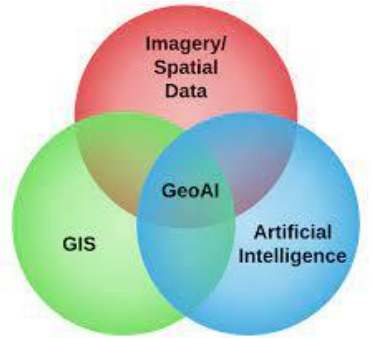
Velodyne Lidar, RIEGL ,Optech ,Faro Technologies, Sick AG ,Leica Geosystems…

ARTIFICIEL INTELLIGENCE

AI, or Artificial Intelligence, refers to the simulation of human intelligence processes by computer systems. These processes include learning, reasoning, and self-correction

- ✓ Analyze data
- ✓ Automate various tasks
- ✓ Identify patterns
- ✓ Identify and classify images
- ✓ Make predictions based on historical data





GeoAI = GIS + Artificial Intelligence

METHODOLOGY

Other Data (weather, demographic, economic, urban ,land use….)

Data acquisition → Data fusion ↔ Data processing → Outcome

LiDAR
Satellite
Aerial
Immersive
GPS
Sensors
etc …

Machine Learning
Deep learning

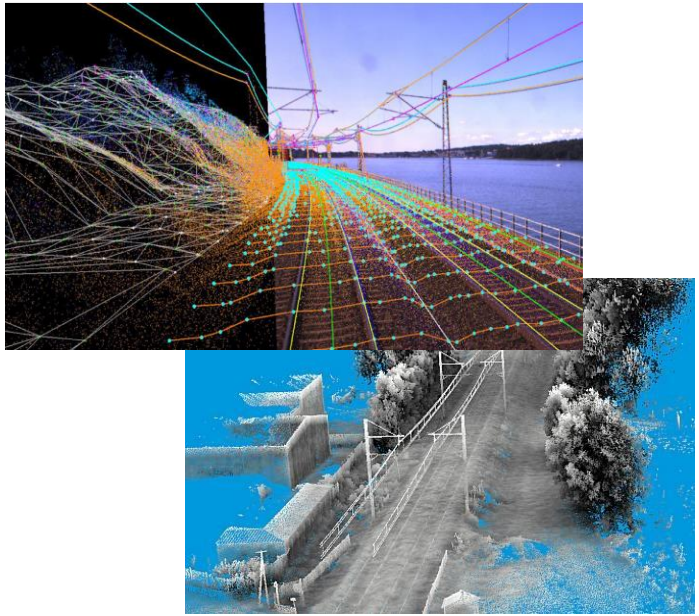
- GIS platform (calculations, controls, visualization, information, etc.)
- Diagnostics and inventories
- Maps
- Dashboards
- Decision tool

USE CASES

Image-LiDAR Fusion

Create a detailed 3D model of the proposed railway route

Visualize the terrain and features along the route, and identify potential challenges such as steep grades, difficult terrain, and areas prone to flooding



Example of AI techniques:

- Multi-View Stereo (MVS) algorithms
- Deep learning-based semantic segmentation

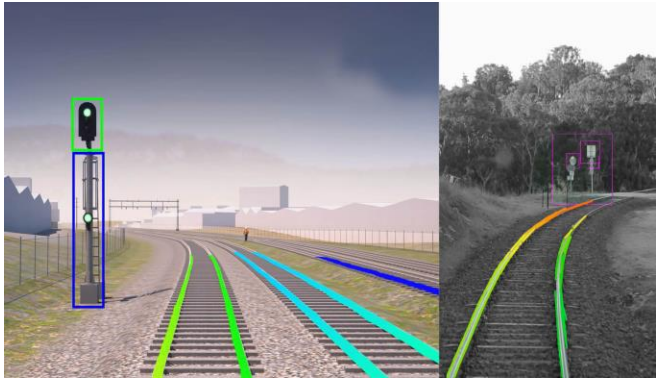
USE CASES

Object Detection and Recognition

Generate object proposals and a region proposal network (RPN) to classify and locate objects

Automatically identify and locate objects in images, such as utility poles, bridges, and culverts

Classify objects based on their characteristics



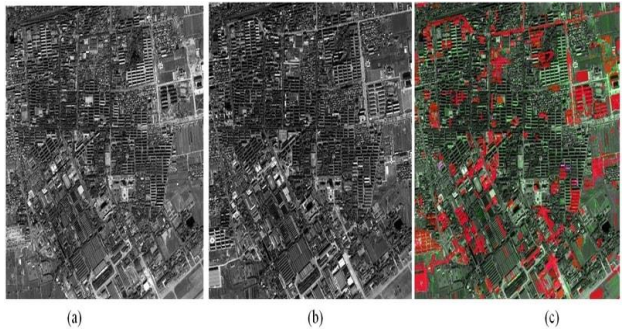
Example of AI techniques :

- Convolutional Neural Networks (CNN)
- Faster R-CNN
- You Only Look Once (YOLO)
- Single Shot MultiBox Detector (SSD)
- RetinaNet

USE CASES

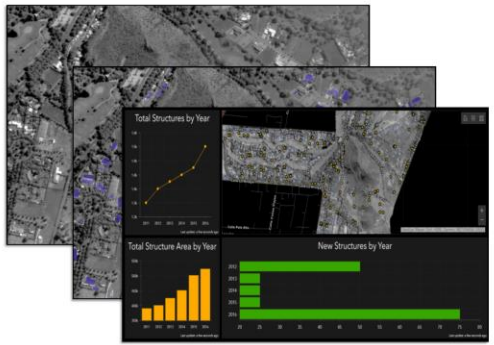
Change Detection

Detect changes in the environment over time, such as new construction, changes in vegetation, and erosion



Example of AI techniques :

- Image Registration
- Object-based Image Analysis (OBIA)
- Multi-Temporal Image Analysis
- Deep Learning-based Change Detection
- Time-Series Analysis



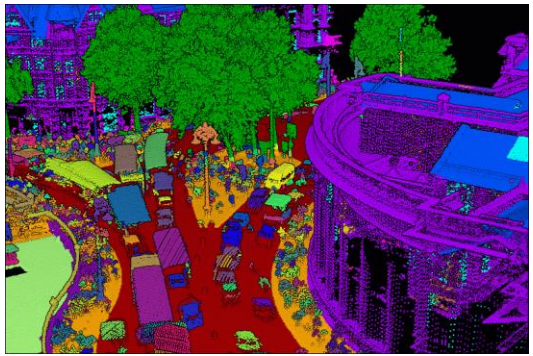
USE CASES

Quality Control and Data validation

Validate and quality control the data obtained from LiDAR, images and satellite imagery

Identify and correct errors, inconsistencies, and unusual values

Improve the accuracy, efficiency, and sustainability of railway network planning and development



Example of AI techniques :

- Data cleaning
- Anomaly detection
- Data augmentation
- Clustering
- Data validation
- Data visualization

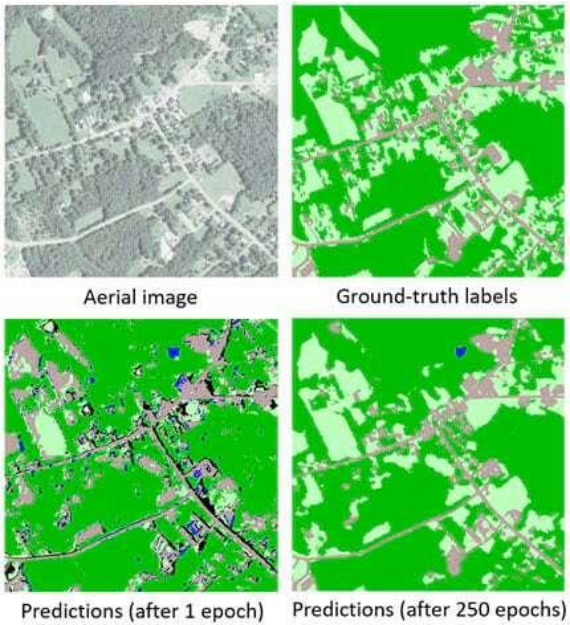
USE CASES

Predictive modeling

Create simulations of how a railway line would be used in the future, based on factors such as population growth, economic development, and travel patterns

Example of AI techniques :

- Data cleaning
- Anomaly detection
- Data augmentation
- Clustering
- Data validation
- Data visualization



CONCLUSION

Benefits

- Create detailed 3D models of the terrain and environment
- Identify potential new markets for rail transportation
- Identify environmental risks
- Upgrade of existing tracks and stations
- Track the progress of construction projects
- Reduce the need for travel to the field for inspections and assessments
- Collect inventories of various railway assets
- Design/construct new stations/intermodal transportation hubs
- Plan new railway lines
- Maintenance of rail infrastructure

Challenges

- Railway territory management becoming more data-driven, utilizing data from various sources (satellite images, lidar, IoT sensors and AI algorithms) to analyze data and make real-time decisions.
- Several challenges must be overcome in order to fully realize the potential of smart railway territory management :
  - Data integration and management can be complex and time-consuming
  - Measures must be taken to secure data and protect against cyber attacks
  - Interoperability with other systems
  - Implementing may require significant investment
  - Maintenance and Upgradation of technologies

THANK YOU

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Marrakech, 7-10 MARCH 2023

A BIM and LCA Tool for Sustainable design of railway infrastructures

Isabella, Selmi
Lead of Standard and Data Architecture, Italferr, Italy
Session5-1.5 Digitalization / Engineering

ONCF UIC

Information Management

The BIM process from design to demolition

MANAGING and STORING information throughout the entire life cycle

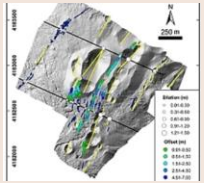
Design data

- Technical Specifications
- Performance Data
- Dimensional Data
- **Materials**
- **LCA Performance Data**

UNI EN ISO 19650-1: 2019
UNI EN ISO 19650-2: 2019

UNI EN ISO 19650-2: 2019

Field Data



- Technical Changes
- Geometrical Data Changes
- Construction Data
- Transport
- Materials
- Time and Costs

As-Built

- Survey of existing works
- Underground census and database
- Material Acceptance Certifications
- Performance Data Sheets
- Manufacturer data
- Maintenance Data

UNI EN ISO 19650-3: 2021
UNI EN ISO 17412-1: 2021

Sustainability Data

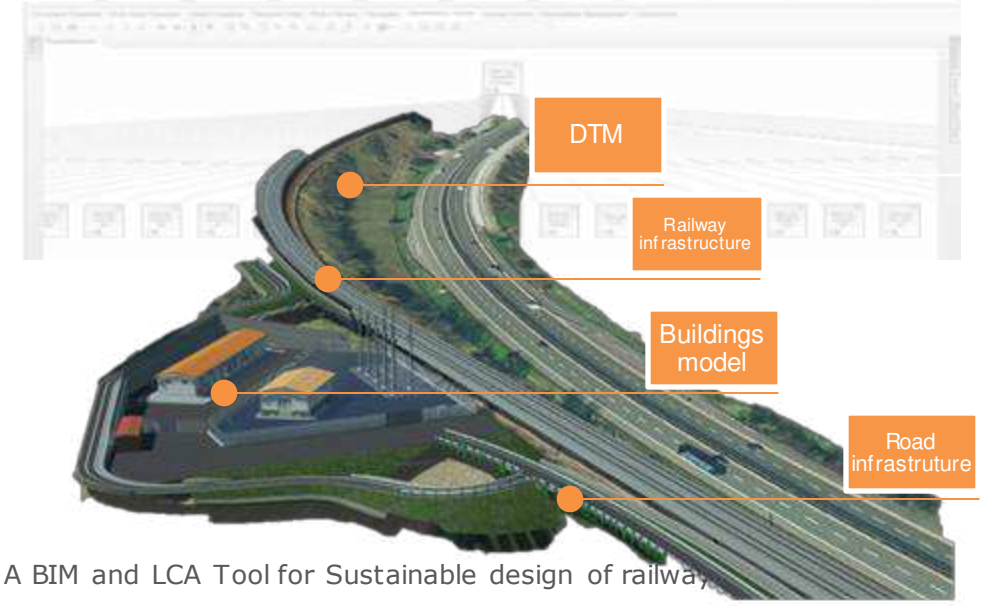
- **Material**
- **Transportation**
- **Manufacturing**

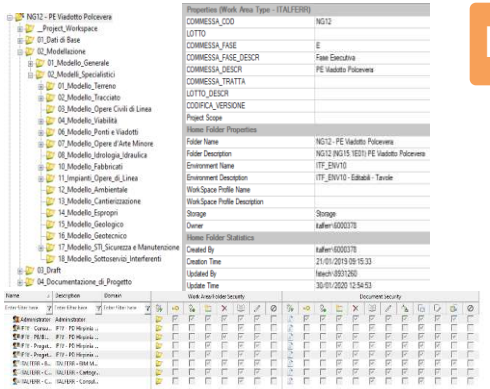
Design and Data Architecture

Setup from the design phase onward

Federated Model

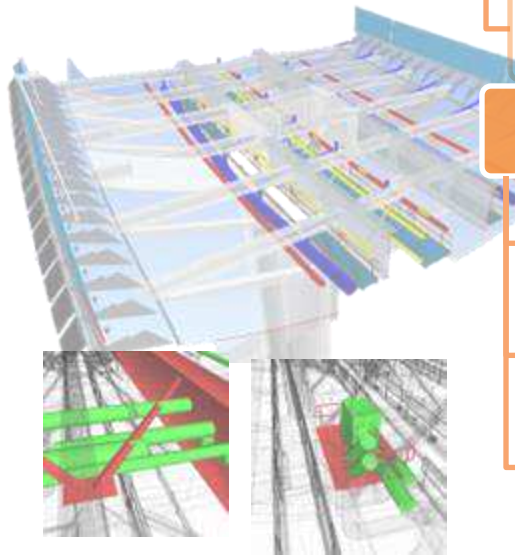
- Terrain Model
- Alignemnt Model
- Roads Model
- Civil Works
- Tunnel Models
- Bridges Models
- Retaining structure Models
- Hydraulic Models
- Station Models
- Land Use Models
- Geotechnical Models





Data Check

- Tracking the project evolution history w ithout loss of information
- Real-time sharing of project information
- Certification of information and the roles that contribute to define it



Quality

- Clash detection activities carried out before the Construction phase
- Minimization of changes during construction.
- Extra cost minimization in the execution and construction phase

Design and Data Architecture

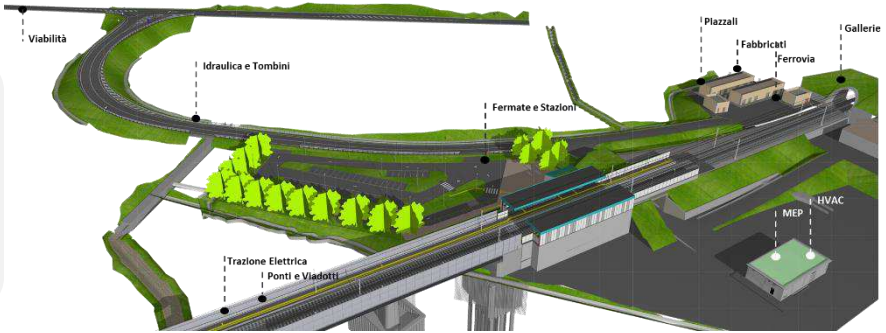
The Federated Model: 3rd lot of the Salerno-Reggio Calabria

- Federated model
  - Context model
  - Building Model
  - Railway Model
  - Bridges Models
  - Roads Models

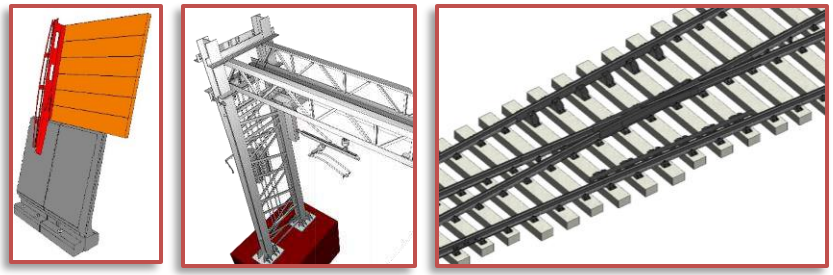
BIM Standardization and Data Management Activities

Standardization of BIM Libraries

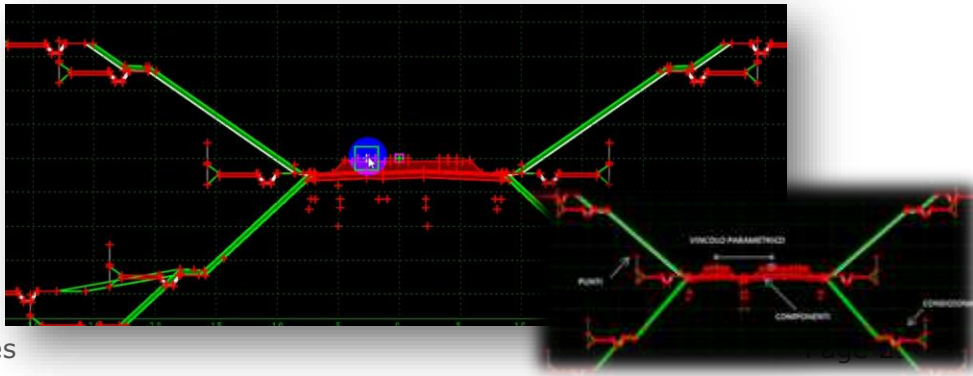
Underlying the production of an informative model of an infrastructure there's the need to structure its individual objects, which form the basic data for BIM design.
Data structure is related to the single phases of the work life-cycle**. Sustainability data** have been analyzed and associated to each object of the BIM library from the Preliminary Design phase



Libraries of parametric components similar to point elements (MEP devices, noise barriers, ...)



Parametric template libraries: digitized type sections that modify their geometric configuration when extruded along plano-altimetric paths



Life-cycle Design and data management

The functional evolution of the process: the **7D Model**

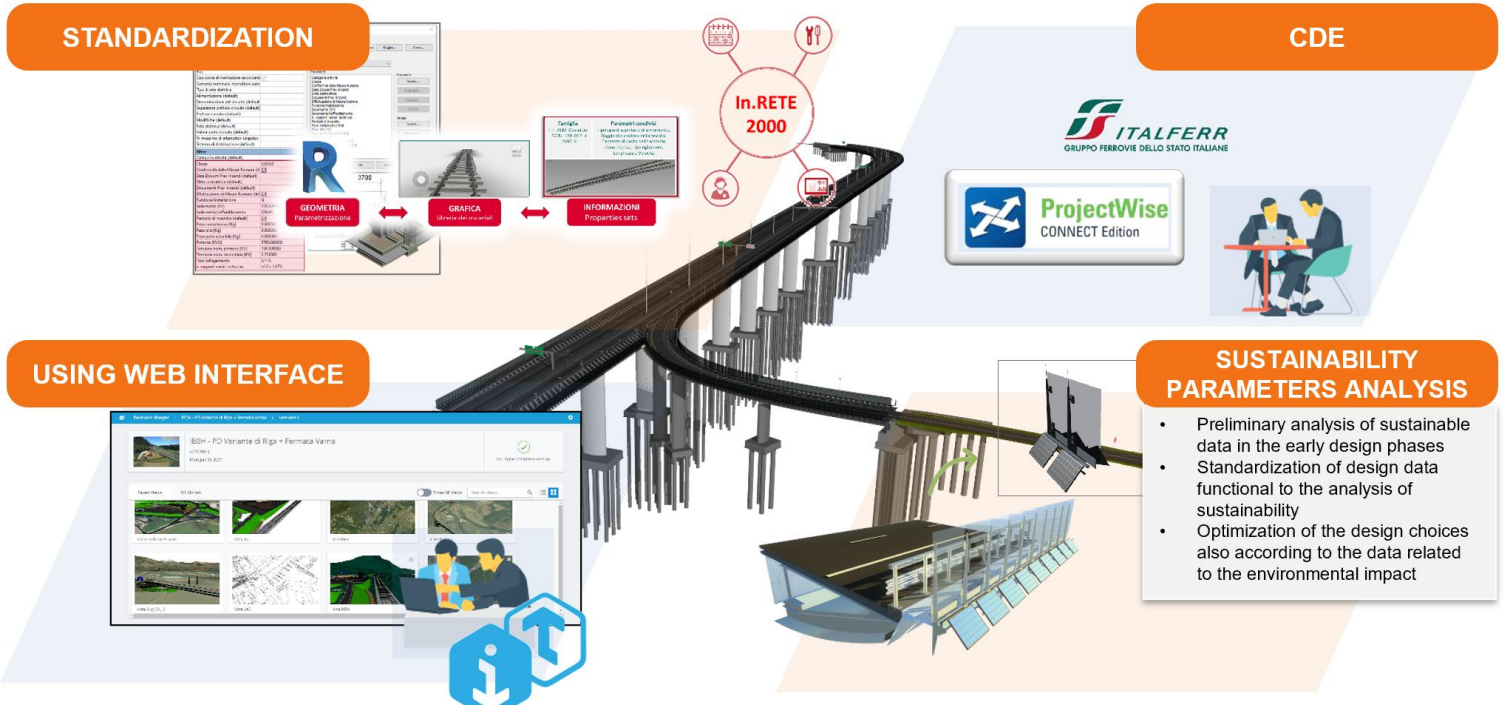
Sustainability as

- an integral part of the design
- dialogue with the communities concerned
- value creation opportunities for future generations

- **Carbon Footprint** (ISO 14064)
- **Life Cycle Assessment** (ISO 14040)
- **Envision Protocol**
- **Stakeholder Engagement**
- **Integrated Management Syste** (ISO 9001 – 14001 – 18001)

Life-cycle Design and data management

The functional evolution of the process



The BIM and LCA Tool for Sustainable design of railway infrastructures

The goal is to develop a platform that, thanks to special algorithms, is able to connect the information entered in the Models in .ifc format with the LCA Information Database in order to obtain environmental impact analysis

The ongoing process

Data aggregation
structured to standardize and organize technical, performance data, referring to materials, field data, maintenance data, which may be available already in the design phase for LCA analysis

Setting up and customizing the algorithm
for LCA analysis, able to read the data coming from Model and connect them to the LCA Database

Defining a merge bridge between IFC Models (exported information) and the calculation algorithm for LCA Database

LCA analysis processing
from interoperable IFC models

The BIM and LCA Tool for Sustainable design of railway infrastructures

Material, Manifacturing and Transport Parameters

MATERIALS

Information concerning

- the composition;
- the physical characteristics;
- the incidence per unit of measurement

TRANSPORTATION

Information concerning

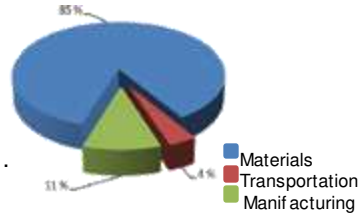
- the type of carrier;
- at maximum load;
- the type of fuel;
- the distance travelled;
- to the scope.

PROCESSING

Information concerning

- the type of machinery hypothesized;
- its power;
- the hourly incidence per unit of measurement of processing;
- consumption (as an alternative to potency and incidence).

The information has been taken from:
-from typological elements;
-from the Manual of execution of Civil works.



The BIM and LCA Tool for Sustainable design of railway infrastructures

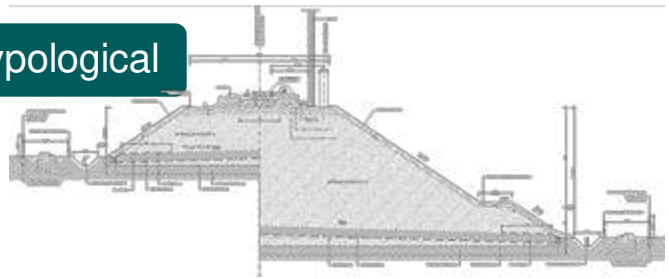
Operational flow for the collection of the information

Traditional process

Cost estimation

Type Sections

Typological



BIM process

Component data enhancement for LCA analysis

Analysis of the information contained in the type sections

Components Modeling

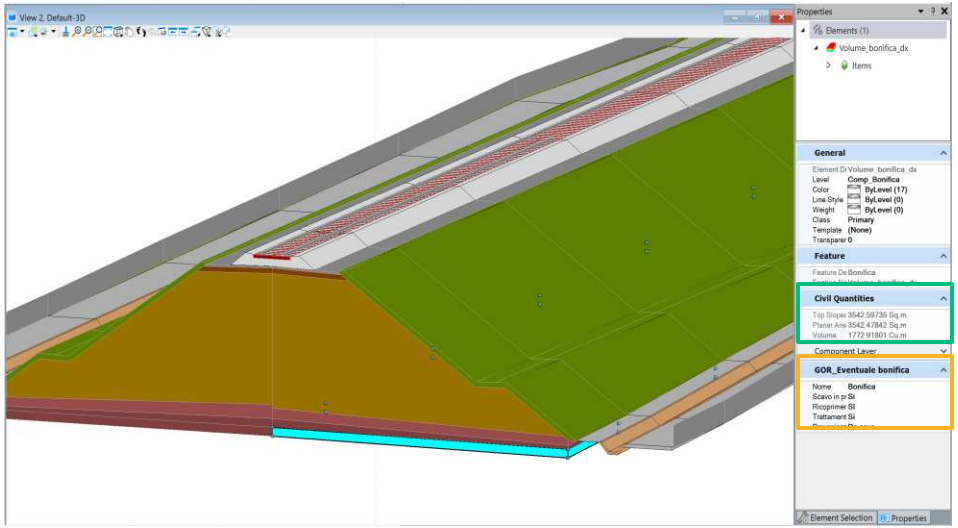
For each element a system of parameterization of the variability of manufacturing has been developed. It is based on the identification of a set of representative properties of the component of the item (GOR).
For each component there may be one or more GORs.
For each GOR, separate LCA analysis datacì can be derived.

The BIM and LCA Tool for Sustainable design of railway infrastructures

The process

- Embankments;
- Cuttings;
- Track;
- Cut&Cover;
- Viaducts;
- Overhead Contact System (OCS)

Infrastructure components analyzed



Analysis of the informative content from the Italferr's design process

Informative parameters coded by standardization process

Parameter associations

IFC Export

THANK YOU

https://www.italferr.it/

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BIM Technologies Research & Application on High-Speed Railway Infrastructure All Life Cycle Management

JIN, Chenkun
Senior Engineer, CARS, CHN
Session5- 1.5 Digitalization Engineering

ONCF UIC

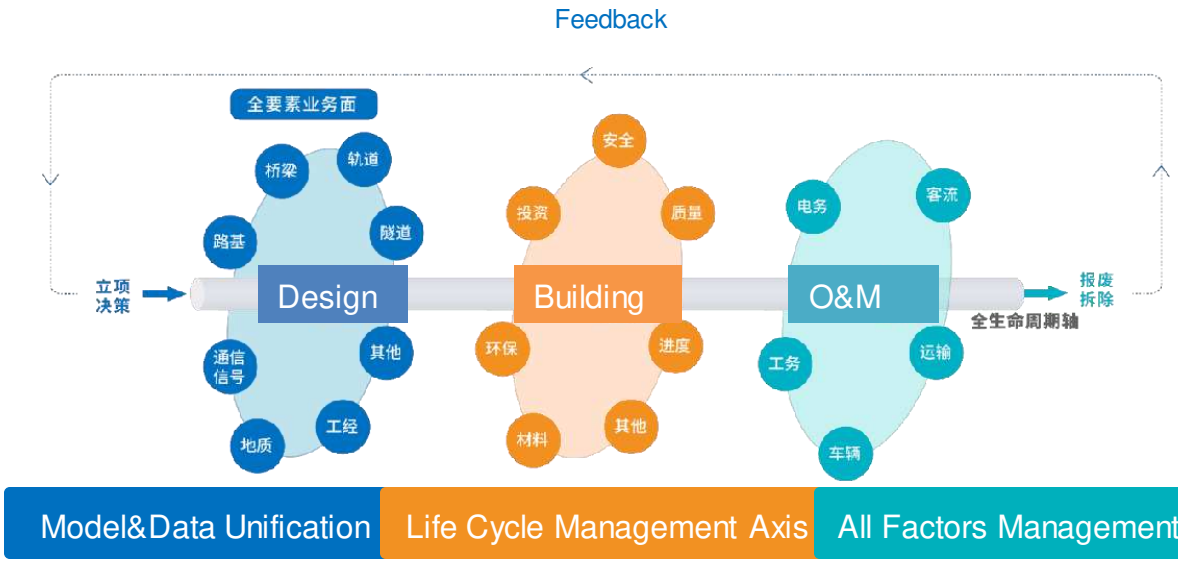
Part 1 Introduction

1.1 Railway Construction Development in China

- 42,000km of High Speed Railways(HSRs) in operation by the end of 2022
- China is the country with the longest mileage of high-speed railways in operation

Part 1 Introduction

1.2 HSRs All Life Cycle(ALC) Management

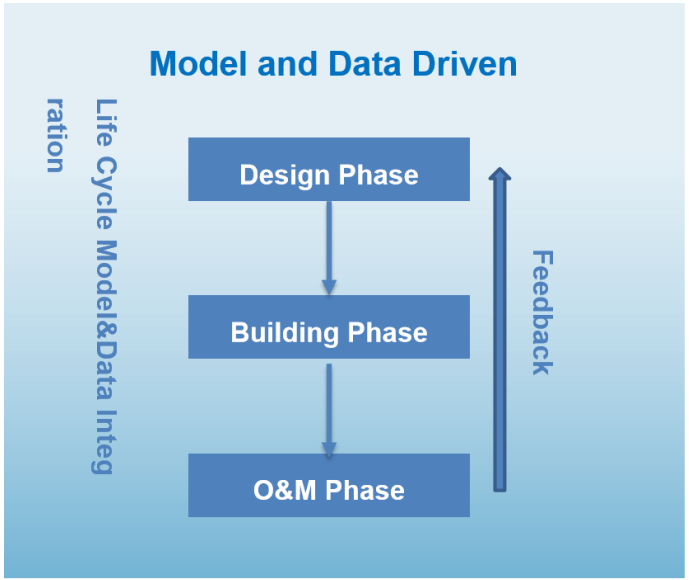


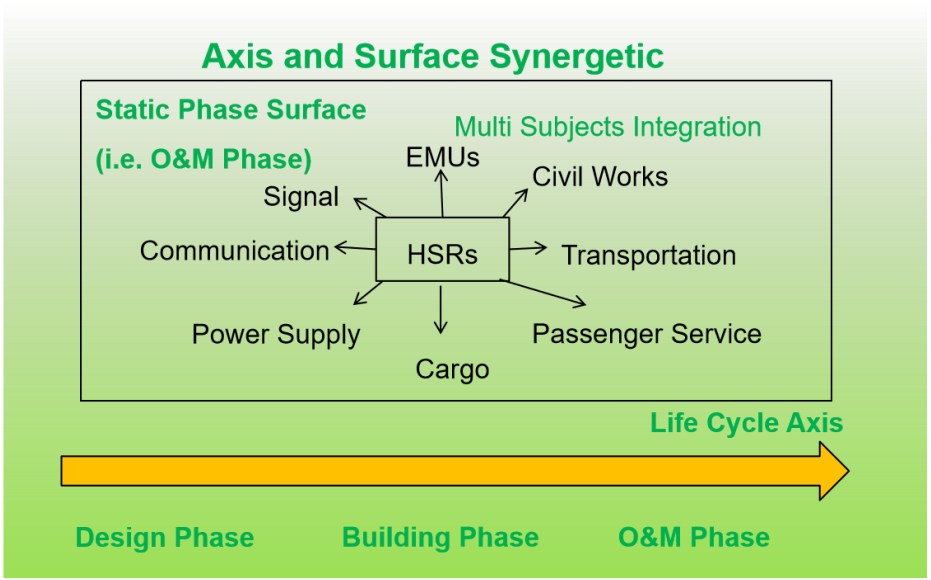
Optimality of the overall benefit of life cycle

Part 2 Approach

2.1 Intelligent HSR engineering management method

- Model and Data Driven, Axis and Surface Synergetic



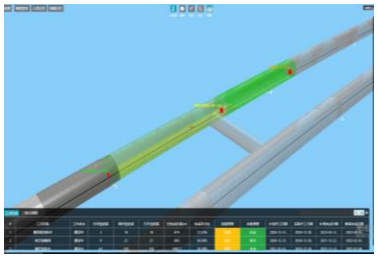


Part 2 Approach

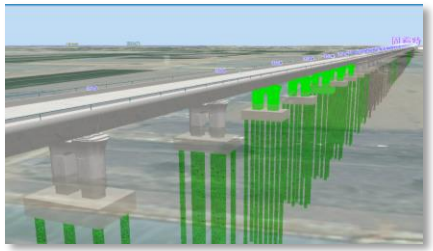
2.2 Models

- Representation Model
- Mechanism Model

Representation Models(BIM)

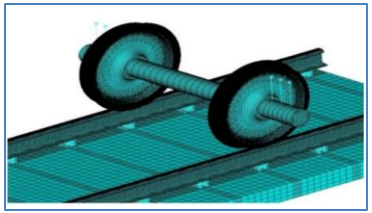


Tunnel

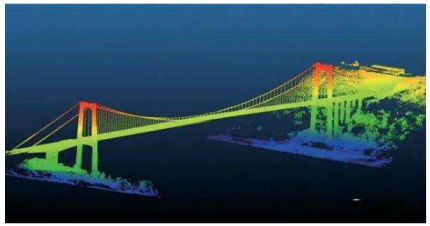


Bridge

Mechanism Models



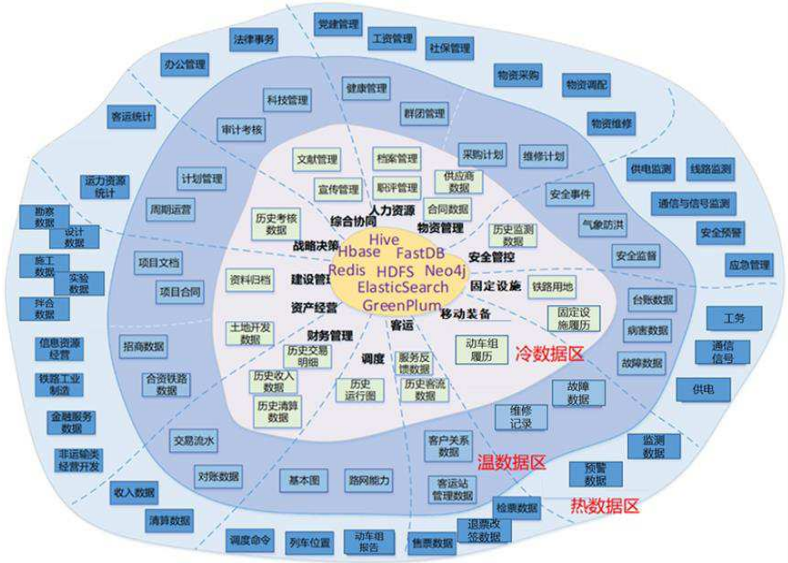
Wheel and Rail Dynamics



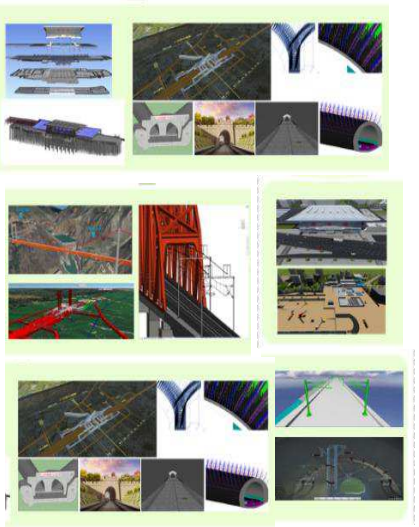
Structural mechanical Analysis

Part 2 Approach

2.3 Data



HSRs Data Lake



HSRs Digital Twin Models

Part 3 Application

3.1 Intelligent Beijing-Zhangjiakou HSR

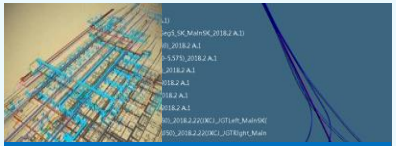
- Design Phase —— Open collaborative design platform
- Building Phase —— BIM engineering management platform
- Operation Phase—— Integrated operation and maintenance platform

Part 3 Application

3.2 HSR Open collaborative design platform

Collaboration Design

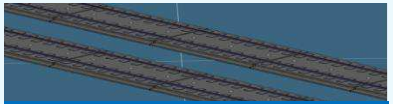
Collabor. Platform



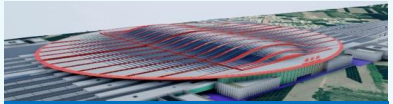
Multi Disciplines

Data Fusion

Visualization Design



Track



Station

Signal

FEATUES

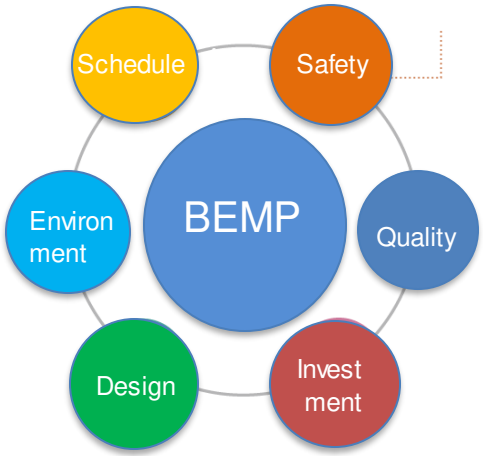
- Multi disciplines collaborate
- Visualization design in 3D (BIM)
- Models and files sharing and digital handover

BENEFITS

- Coordination time save -8%
- Material cost save -3%
- Avoid design conflicts

Part 3 Application

3.3 BIM based Engineering Management Platform (BEMP)



- Management Factors
- Man, Machine, Material, Method, Environment (4M1E)

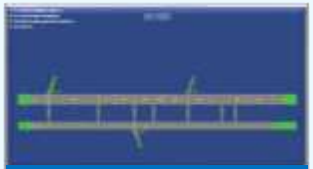
Information Perception

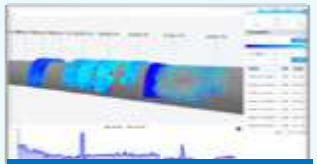

Cement Station

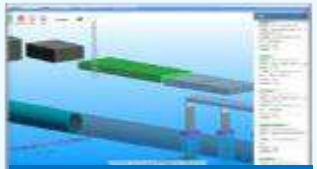

Bridge Linearity


Tunnel Rock

Progress Control

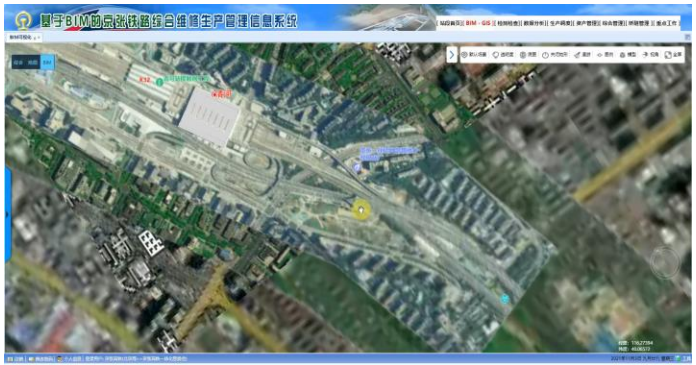

Critical Path

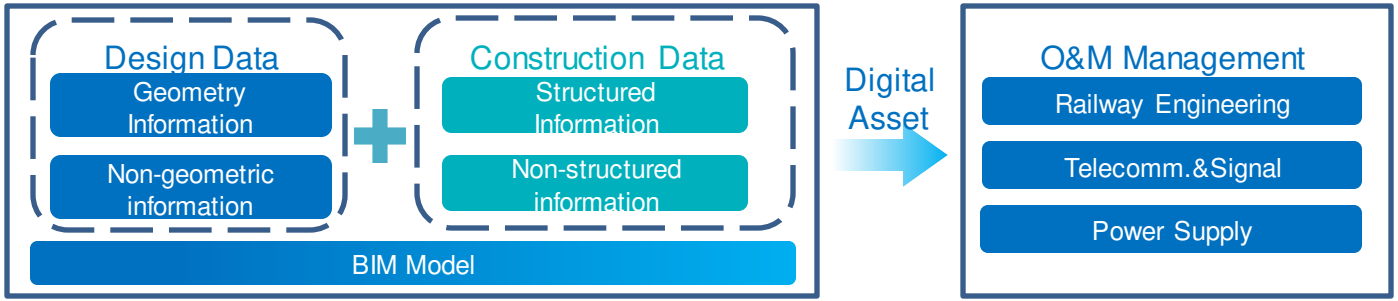

Surface Quality


Hazard Simulation

Part 3 Application

3.4 HSR Operation and Maintenance Platform





Part 4 Conclusion

Benefit and improvement

- Design Phase —— Open collaborative design platform

  Improve design quality & productiveness; reduce rework.

- Building Phase —— BIM engineering management platform

  Reduce labor amount, higher efficiency, higher quality.

- Operation Phase—— Integrated operation and maintenance platform

  Enable digital infrasturcture, fulfill HSRs life cycle management.

THANK YOU

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Session 5-1.5 Digitalization / Engineering

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