AUTODESK UNIVERSITY

BIM in SNCFR Digital Transformation

TR501801

PhD JUDICAEL DEHOTIN
Deputy Director Sncf Reseau BIM program

ABOUT ME

PhD JUDICAEL DEHOTIN

Deputy director of the SNCF BIM program and responsible of BIM Implementation at SNCF Reseau for design, construction and operation phases : Head of Implementation strategy on railways projects, tooling strategy in respect of current railways process and for BIM in training planning.
Nominated expert in the European program *Europe's Rail-System Pilar*.

System engineering/architecting expert involved in the main Sncf and European innovation program on railways system Architecting. I lead Sncf activities in IFC Rail project (IFC 4.3) as stakeholder for railways domains specifications.

I'm civil engineer specialized in hydraulic with strong experience in the design of civil engineering structures. PhD in physical multi-dimensional modelling in water and the environment domain.

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Learning Objectives

1. **Introduce Railways issues** and challenges for BIM technologies

2. Understand the **importance of railway requirements management** in BIM use cases

3. Understand the **role of data and interoperability** for rail systems integration

4. Become aware of the importance of **the place of data transfer** in relation to geometry and CAD

5. For software developer **understand railways challenges** for BIM software

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SNCF RESEAU IN A NUTSHELL

FRENCH RAILWAYS INFRASTRUCTURE MANAGER

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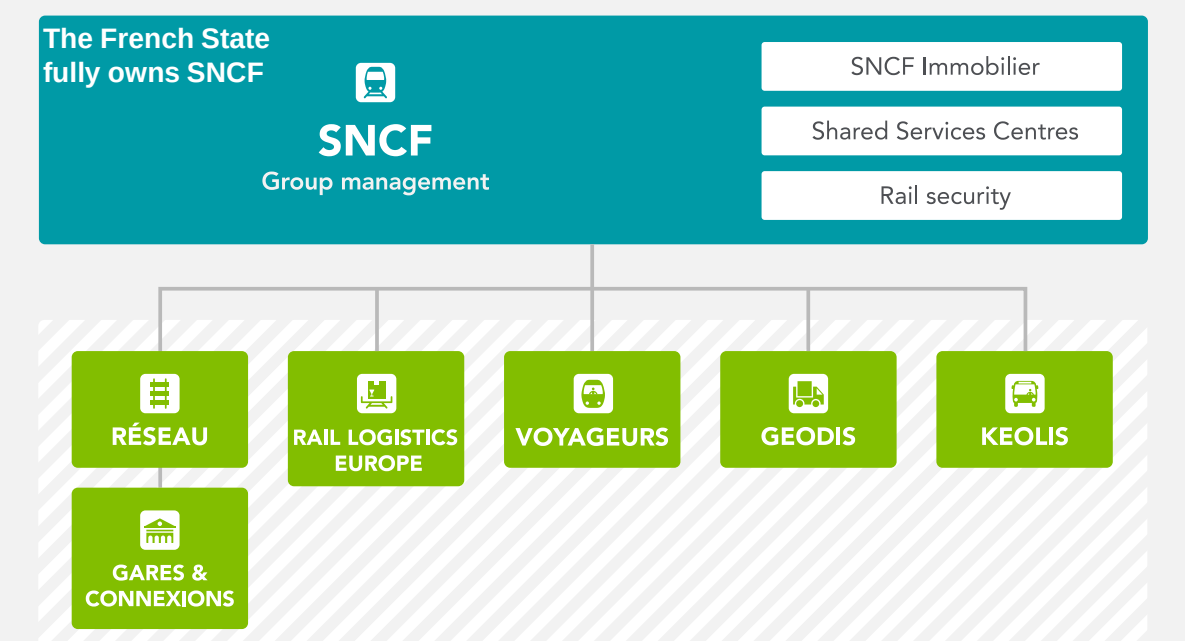
SNCF RESEAU : A SNCF GROUP COMPANY



30 BILLION € IN SALES EACH YEAR

> 260 000 person

960 subsidiary in 120 Country

3,000 Stations

20,000 train path delivered every day

Champion in **European highspeed rail**.

The total rail network is the world's second densest, and we rank second in mass transit.

In short, we're a leader in passenger transport and freight logistics in France and around the world

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EUROSTAR™ Paris - London

THALYS Paris - Brussels - Amsterdam

GEODIS Multimodal freight & freight forwarding

KEOLIS World leader in day to day mobility

RAIL LOGISTICS EUROPE Rail Freight Transport & logistics

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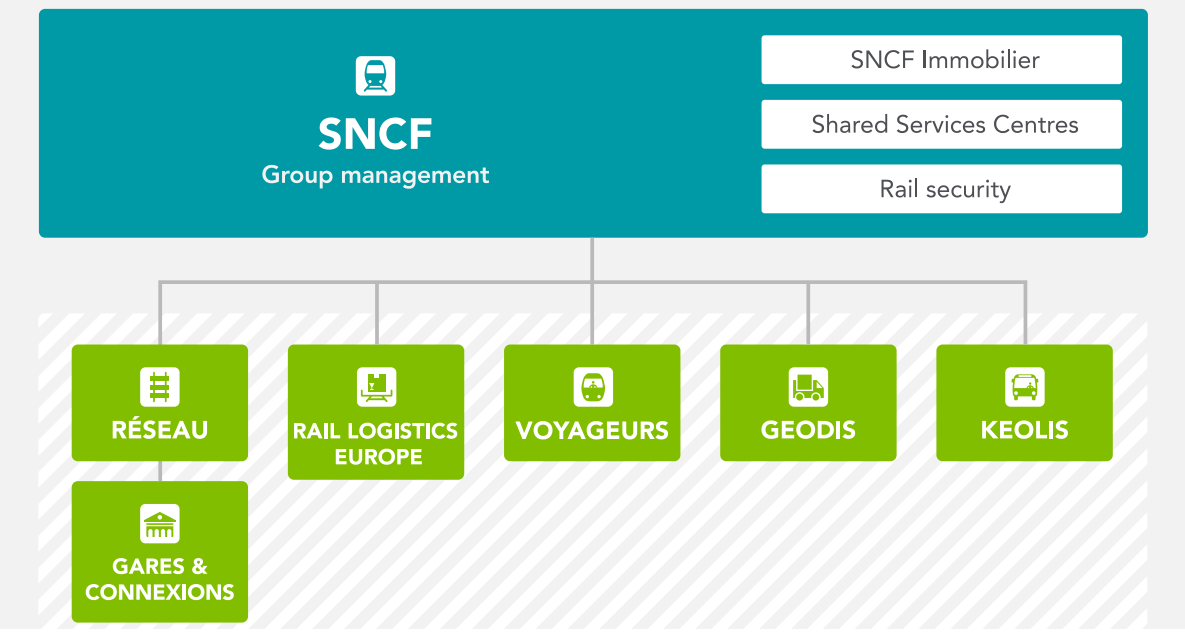

Keolis operates bus, metro, light rail and coach networks, rental bikes, carparks, boat shuttles, cable cars, trolleybuses and airport services.

10 networks in seven countries: China, Côte d'Ivoire, the United Arab Emirates, France, India, Qatar, United Kingdom, automated metro in Dubai

Geodis specializes in freight transport logistics in France and 120 countries worldwide.

International group present in several countries (170) through its subsidiaries

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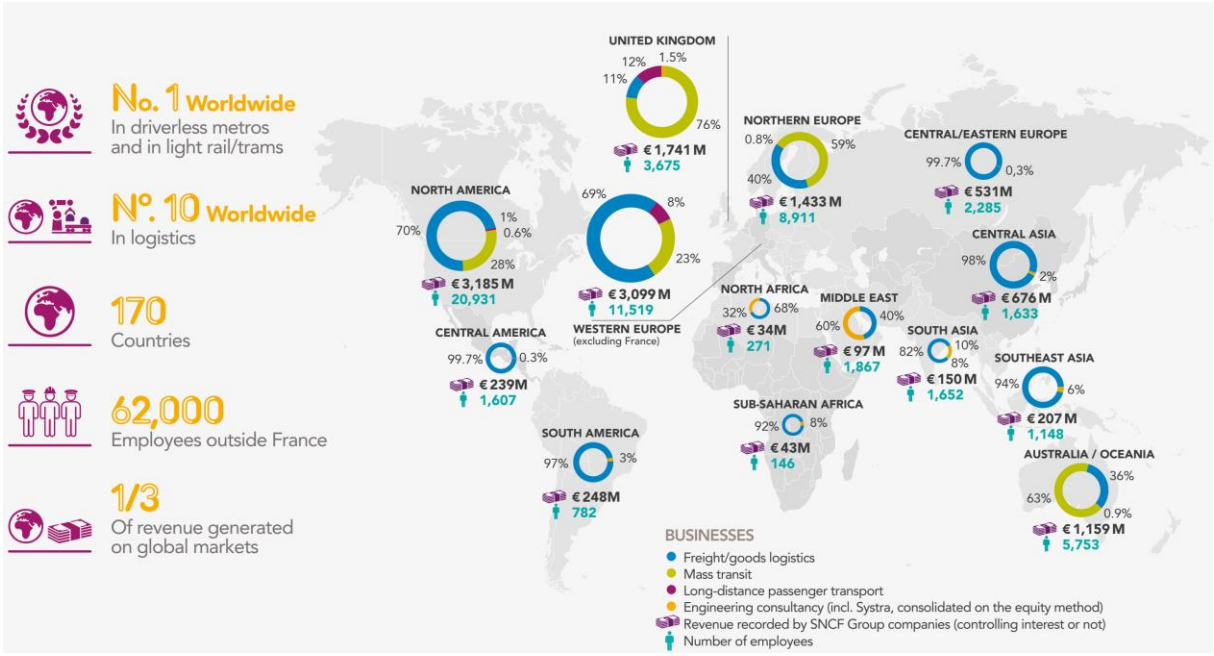

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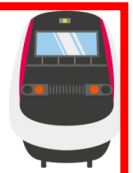
SNCF RESEAU IN A NUTSHELL

SNCF RÉSEAU, A MAJOR PLAYER IN THE DEVELOPMENT OF THE FRENCH RAILWAY SYSTEM

2020 IN FIGURES

28,000 KM
of lines in operation
including 2,700 km
of high speed lines



2.538
billion €
devoted to renewing tracks

15,000
trains every day

745 km
of tracks
renewed
every year

28,000 m²
of solar cell panels

250,000
tonnes
of goods
transported
every day

5 million
passengers
every day

3,000
stations & halts

2.145
billion €
invested in development
projects
for the national network

42 customers
including railway companies for
passengers, freight and transport
on the French railway network
(intermodal transport, ports)

5.87
billion €
in sales

20,000
train paths delivered
every day

10.9 million
tonnes of greenhouse gas
emissions avoided
as a result of preference
for transport by rail

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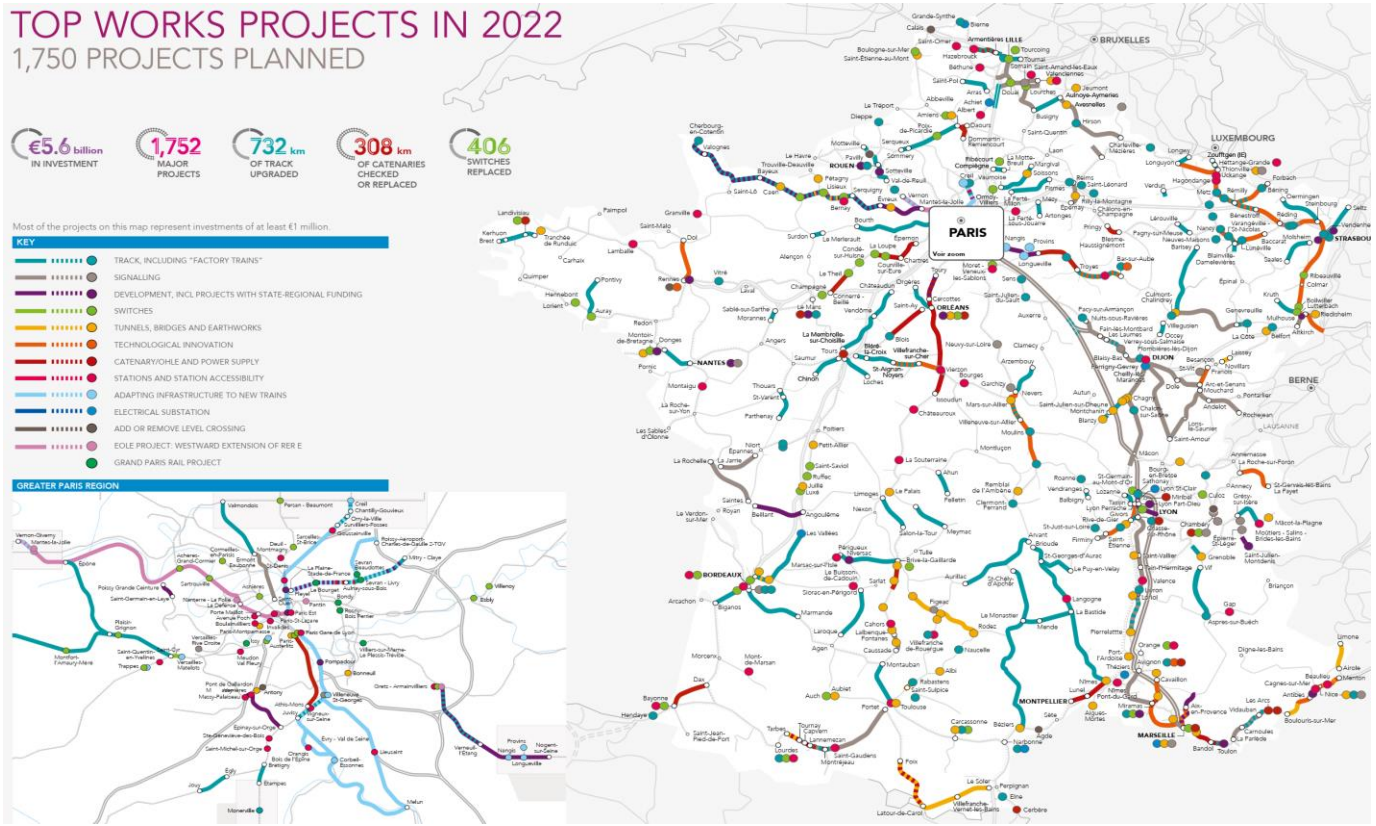
SNCF RÉSEAU OWN FRENCH RAILWAYS NETWORK

SNCF RESEAU IN A NUTSHELL

SNCF RÉSEAU, A MAJOR PLAYER IN THE DEVELOPMENT OF THE FRENCH RAILWAY SYSTEM

These work (1,700 each year) mobilizes all the actors of the ecosystem

They are relative to catenary signalling, track or civil works on the whole of the French rail network



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SNCF RESEAU ACTIVITIES

RAILWAYS INFRASTRUCTURE MANAGEMENT FROM DESIGN TO OPERATION

- RAILWAYS **NETWORK SERVICES** FOR RAILWAYS UNDERTAKING
  - STATION AND NETWORK SERVICES : FREIGHT AND PASSENGERS
  - PATH ALLOCATION AND MANAGEMENT
- RAILWAYS **NETWORK OPERATION AND COMMAND**
  - DISPATCH TRAFFIC
  - CONTROL AND COMMAND
  - MANAGE STATIONS
- RAILWAYS **INFRASTRUCTURE SYSTEM ENGENIERING** (FROM DESIGN TO OPERATION).
  - INFRASTRUCTURE **RENEWAL AND DEVELOPPEMENT**
  - **MONITOR AND MAINTAIN** INFRASTRUCTURE OPERATIONAL

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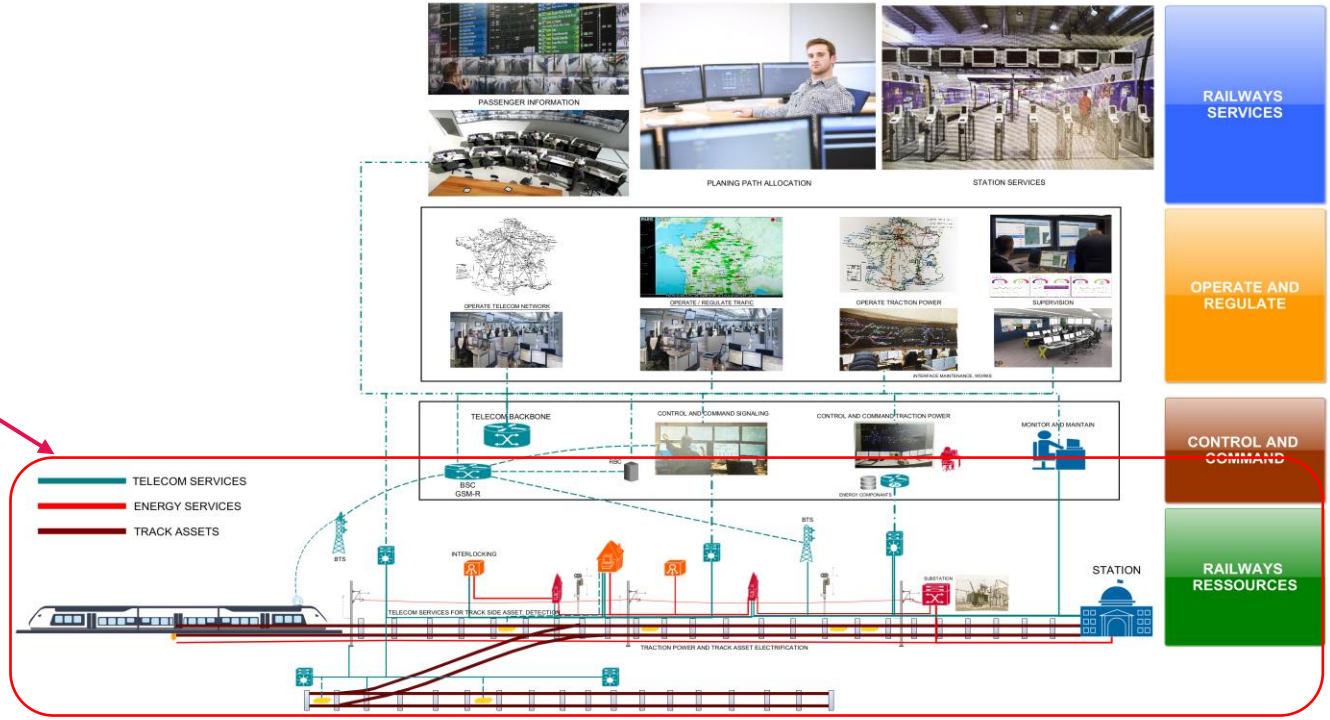
SNCF RESEAU ACTIVITIES

RAILWAYS INFRASTRUCTURE MANAGEMENT FROM DESIGN TO OPERATION

RAILWAYS INFRASTRUCTURE SUB-SYSTEM : INTEGRATED MULTI DOMAIN ENGENIERING

BIM

CONTROL COMMAND
TRACK
ENERGY
TELECOM
SIGNALING
CIVIL WORKS



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SNCF RESEAU ACTIVITIES

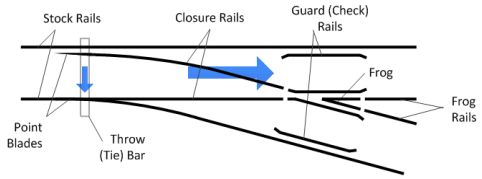
RAILWAYS INFRASTRUCTURE MANAGEMENT FROM DESIGN TO OPERATION

RAILWAYS SYSTEM ENGENIERING/INTEGRATION

- TRACK SUBSYSTEM
- ENERGY SUBSYSTEM
- TELECOM SUBSYSTEM
- SIGNALING SUB SYSTEM
- CIVIL WORKS

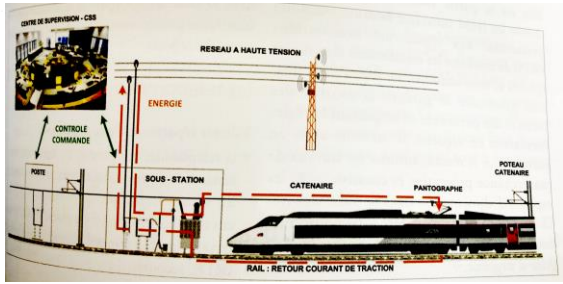
Railways IM are not just building infrastructures, Integrate system created in such a way that they work together without interfering with each other

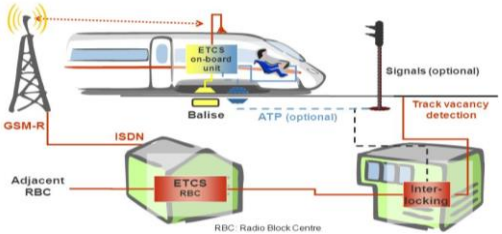
TRACK

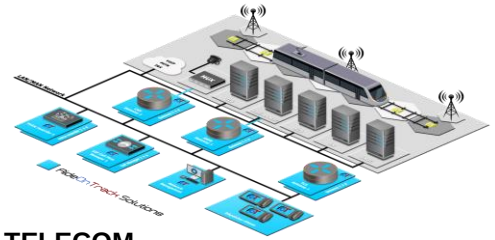


TRACTION POWER

SIGNALING







TELECOM

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SNCF RESEAU ACTIVITIES

RAILWAYS INFRASTRUCTURE MANAGEMENT FROM DESIGN TO OPERATION

RAILWAYS SYSTEM ENGENIERING/INTEGRATION

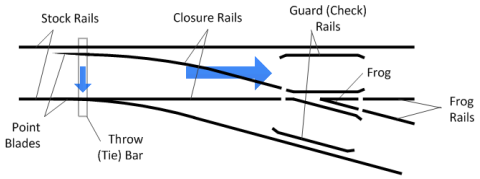
the regulatory context is quite restrictive due to the risks for the safety of people

A distinction is made between

- **local authorities** ➔ local infrastructure developments,
- At national level **transport authorities** as well as **railway safety authorities.**
- **At the European level** there are also rules for transport between countries.

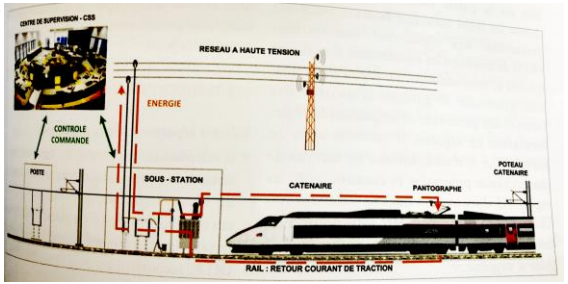
Since software contributes to safety, all tools that are used directly in the system operation or to produce critical information **must be certified by the EN-50128 and EN 50129 standard on Railway applications - Communication, signalling and processing systems**

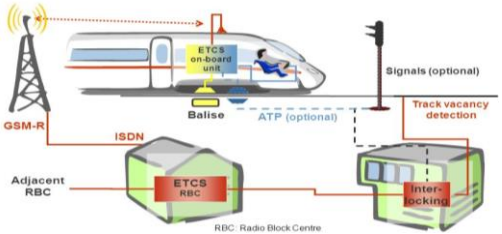
TRACK



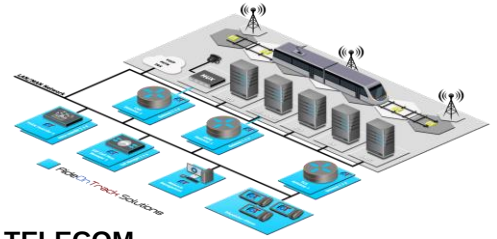
TRACTION POWER

SIGNALING





TELECOM



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SNCF RESEAU ACTIVITIES

RAILWAYS INFRASTRUCTURE MANAGEMENT FROM DESIGN TO OPERATION

Vision for the railway network in 2030

Regeneration
of the infrastructure
focused on **safety**

A network
that adapts to
the needs of
everyday life
(major projects in
Île-de-France,
Metropolitan Express
Services
in the regions)

A network that is a
member of
High Speed Europe

Industrial
programmes
that highlight
digitalisation
and productivity

More **efficient**
maintenance and
operations

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SNCF RESEAU ACTIVITIES

RAILWAYS INFRASTRUCTURE MANAGEMENT FROM DESIGN TO OPERATION

SNCFR SETUP SEVERAL DIGITAL PROGRAM IN ALL DOMAIN (Including BIM program)

HIGH LEVEL SNCF RESEAU AMBITION

- HIGH PERFORMANCE NETWORK
- SUPERVISION AND MAINTENANCE
- ENVIRONEMENTAL PERFORMANCES, BIODIVERSITY PROTECTION…
- LOWER MAINTENANCE COSTS

THE DEPLOYMENT OF BIM AIMS TO CONTRIBUTE TO THESE ISSUES THAT STRONGLY CONDITION THE BIM STRATEGY OF SNCF RESEAU AS WELL AS THE RESULTING REQUIREMENTS

SEVERAL DOMAINS AND BUSINESSES WITH DIFFERENT TOOLS MUST BE COORDINATED TO REALIZE INTEGRATED SYSTEMS THAT WORK IN THIS CONTEXT, EXCHANGES OF INFORMATION ARE CRUCIAL.

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SNCF RESEAU ACTIVITIES

RAILWAYS INFRASTRUCTURE NEED MULTI DOMAIN COORDINATION

OUR BILIEFS FOR BIM DEPLOYEMENT

INTEROPERABILITY OF BIM MODELS FOR DIGITAL CONTINUITY OVER THE LIFECYCLE

→ ISO **STANDARD** (> IFC 4.3) FOR BIMODAL RAILWAY OBJECTS (AS MUCH AS POSSIBLE)

→ NON-PROPRIETARY/OPEN FORMATS FOR DATA TRANSFERT

MULTI SOURCES/TOOLS DATA FOR COORDINATION FOR SYSTEM INTEGRATION

→ AN OPEN, MULTIFORMAT AND "AGNOSTIC" **COMMON DATA ENVIRONMENT** (BIM LEVEL 2)

→ CRITICAL MULTI DOMAIN INTEGRATION : **OPEN FORMAT REQUIRED**

ECONOMY OF CREATION/SHARING OF MODELS AND OBJECTS : FOCUED ON VALUE

→ OPEN **REFERENCE OBJECT LIBRARY** (**BIBLIOBIM**) CO-CONSTRUCTED AND SHARED WITH THE SECTOR

→ "FRUGALITY OF THE MODELS?", **BIM FOR VALUE**

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OVERVIEW ON BIM DEPLOYEMENT AT SNCF R

SNCF BIM PROGRAM

BIM DEPLOYEMENT AT SNCF R

The Reason for existence: Why BIM Program ?

The purpose of the BIM and digital continuity program is to **accelerate the digitalization** of the **design, construction, maintenance and operation of the railways system.**

It facilitates digital continuity during these different phases of the infrastructure life cycle and **contributes to the objectives of the high-performance network**.

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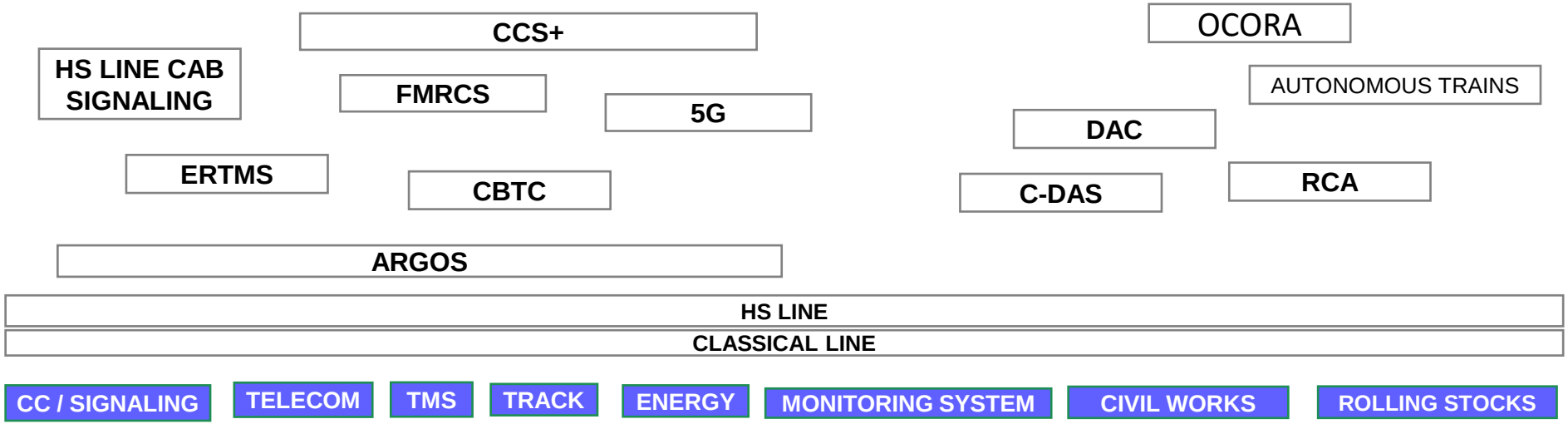
BIM DEPLOYEMENT AT SNCF R

BIM at SNCF Reseau : Deploy BIM on high-stakes issues



- MULTIPLE REQUIREMENTS, IN EXTENTION OF RAILWAYS BASIC REQUIREMENTS
- EACH IM IMPLENTS DIFFERENTS CONCETPS REGARDING PROJECTS OBJECTIFS
- HOW TO HAVE CONTROL ON GLOBAL PERFORMANCE OR TO CONTROL COLLECTIVE PERFORMANCE AT EU SCALE ?

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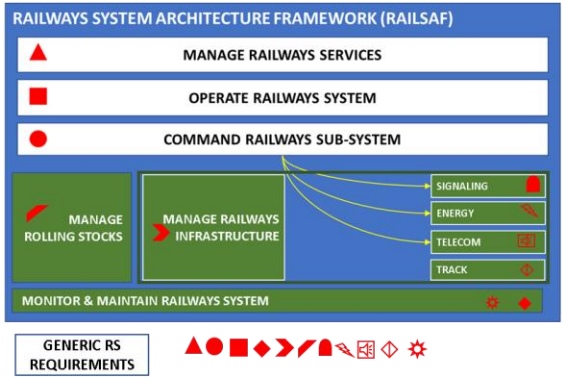
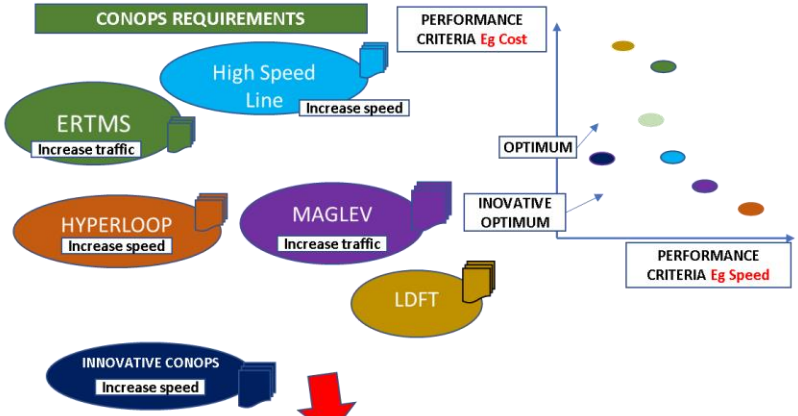
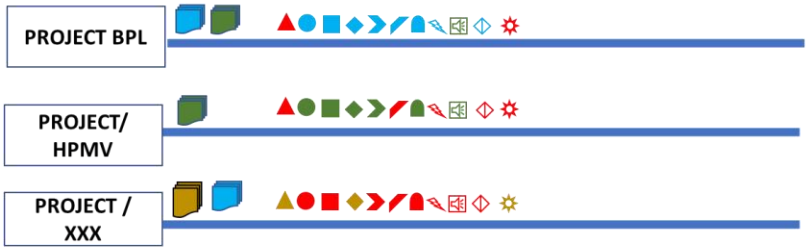
BIM DEPLOYEMENT AT SNCF R

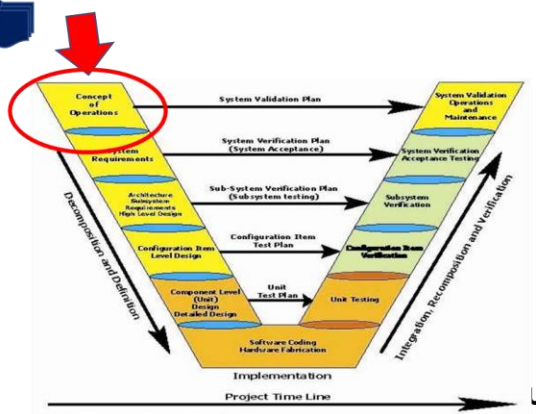
BIM at SNCF Reseau : Deploy BIM on high-stakes issues

RAILWAYS SYSTEM ENGENIERING /INTEGRATION









BIM DEPLOYEMENT AT SNCF R

BIM at SNCF Reseau : Deploy BIM on high-stakes issues

RAILWAYS SYSTEM ENGENIERING /INTERGRATION

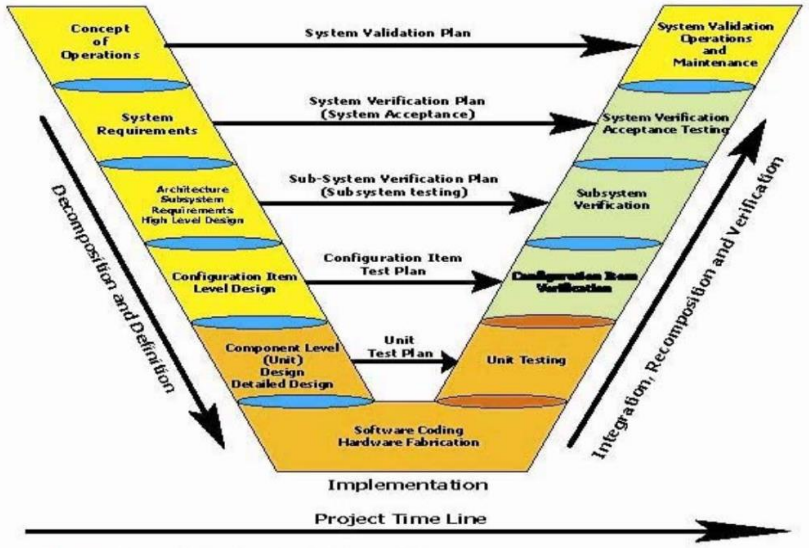
MAJOR ISSUE IS SYSTEM INTEGRATION

SYSTEM PERFORMANCE (TECH AND GREEN)

SYSTEM RE-INGENIERING (Design to value)

- ❑ TRACK SUBSYSTEM
- ❑ ENERGY SUBSYSTEM
- ❑ TELECOM SUBSYSTEM
- ❑ SIGNALING SUB SYSTEM
- ❑ CIVIL WORKS

→ **ALL DOMAIN SYSTEM INTEGRATION**



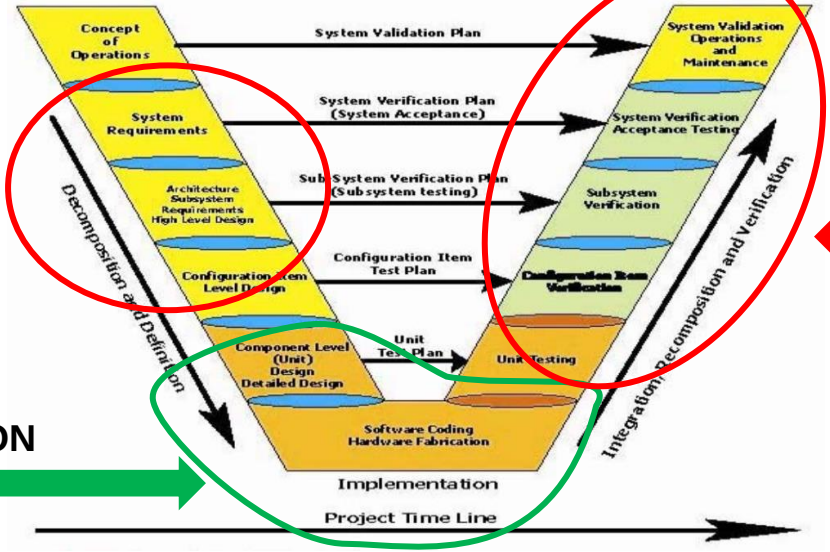
Integrate software, data, electronics, civil works, hardware, process, "Humanware" , through hundreds of miles

BIM DEPLOYEMENT AT SNCF R

BIM at SNCF Reseau : Deploy BIM on high-stakes issues

RAILWAYS SYSTEM ENGENIERING /INTERGRATION

EARLY PHASE
NO connexion to BIM Tools



FROM TEST TO VALIDATION PHASE
Very Few relevant connexion with BIM Tools

DESIGN / CONSTRUCTION

BIM SHOULD BE CONNECTED TO OTHER TOOLS USED FOR THE MAJOR ASPECT OF THE V CYCLE !

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BIM DEPLOYEMENT AT SNCF R

BIM Program Roadmap: 3 step approach

- **Develop capabilities**
  Development of BIM in high value trades and use cases
  BIM standards for reliable data exchange to prescribe internally and externally
- **Engaging the AMOs** and Project Managers (greenfield and brown field)
- Definition of the principles for sharing the value with the ecosystem (contractual framework)
- **Preparing the interface with IT systems and data channels** via concrete cases that mobilize all stakeholders
- **Monitoring of IT technologies** and BIM production tools

- **Control of BIM tool and process requirements** and digital continuity on projects:
  From the design to the construction phase
  From the construction phase to the operation and maintenance phase
- Industrializing the use of the **BIM platform (CDE)** and **BiblioBIM**
- Industrializing the connections between the BIM platform and the IT databases:
- Robust **contractual models** with external actors
- Robust **BIM data continuity** with the IT infrastructure and the information system

- Digital continuity between BIM and **Digital Twin** over the entire infrastructure lifecycle
- Concrete case of use of the Digital Twin on the national railway network

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BIM DEPLOYEMENT AT SNCF R

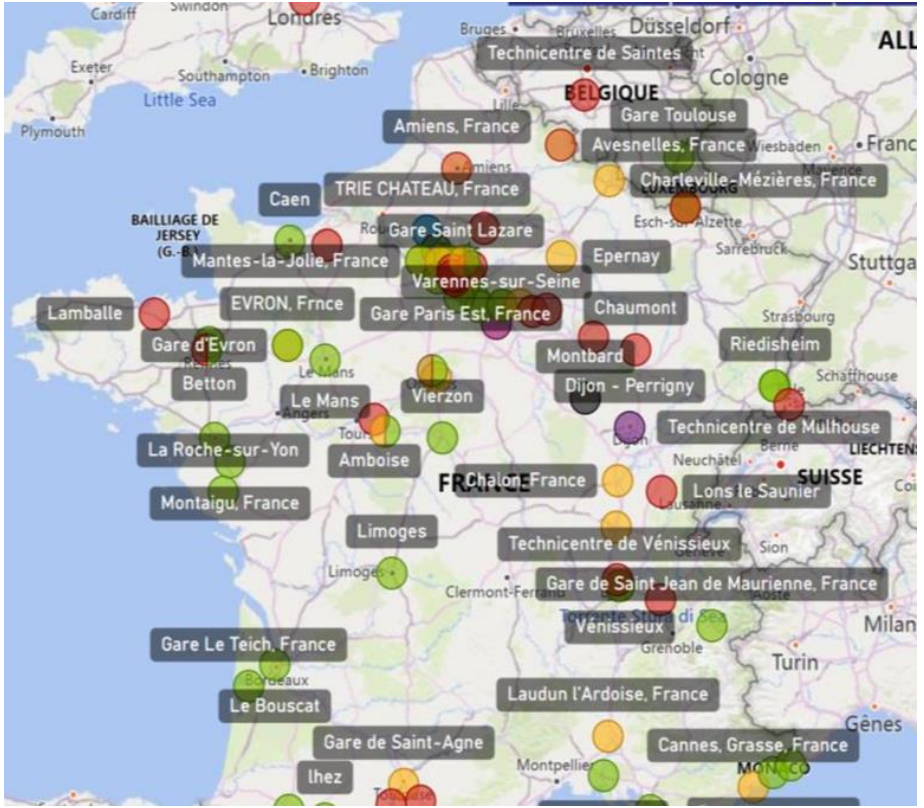
INDUSTRIALIZATION OF BIM FOR DESIGN/CONSTRUCTION PROJECTS

Current BIM projects

+ More than **160 projects** in progress or completed in BIM.

+ **Capacity development** in several entities and business lines (40 entities and more than 1000 people trained)

+ **Change management**: BIM Champions network, and engineering



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BIM DEPLOYEMENT AT SNCF R

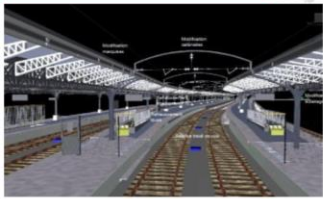
INDUSTRIALIZATION OF BIM ON RAILWAYS DESIGN/CONSTRUCTION PROJECTS

Main **BIM use cases** implemented and documented

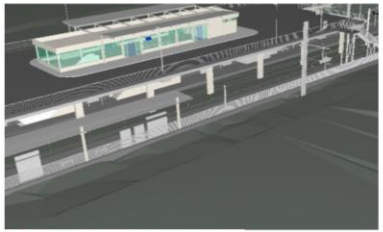
- Platform
- Telecom
- Signaling
- Energy
- Track...

Several uses case were developed with Autodesk France

PRI REIMS
Champagne-Ardenne

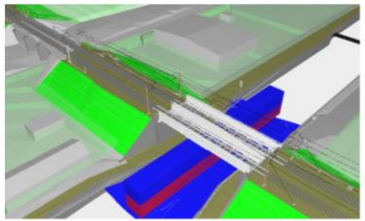


SDA gare de Paris Est
Multi Métiers - Multi sites
Coordination BIM (PRI/AREP); Phasage 4D

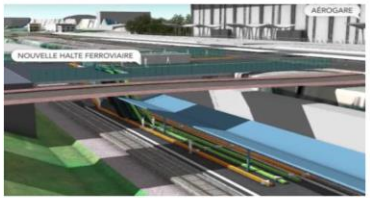


ORLY RUNGIS gare TGV
Multi Métiers - Multi sites
Coordination BIM (INGEROP/AREP); Phasage 4D.

PRI STASBOURG
Alsace

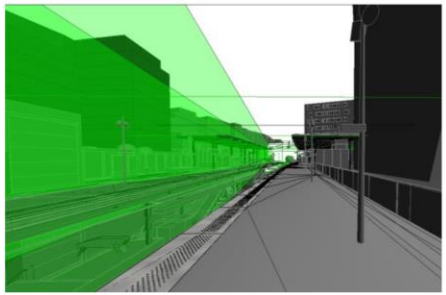


Remplacement de tabliers PRA de Riedisheim
Métiers OA EG TL ES; Phasage 4 D

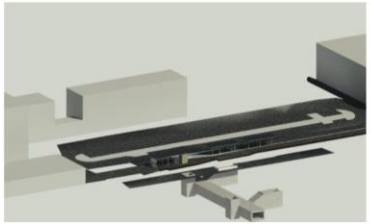


Projet EuroAirport
Multi - Projets / Multi - Métiers
Phasage 4 D; Interfaces Projets: Extension Aérogare / Prolongement Tram; A35 / ZAC / Centre Commercial / Piste Cyclable

PRI AMIENS LILLE
Haut de France



Agrandissement BV Issy les Moulineaux
Métier EG (rehaussement quais + réseaux d'assainissement
Coord. BIM AREP



Interconnexion en Gare de Bondy
Métiers OA EG TL ES EE; Phasage 4 D

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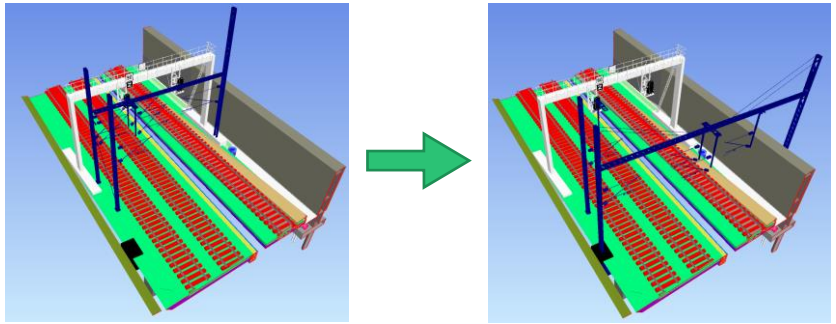
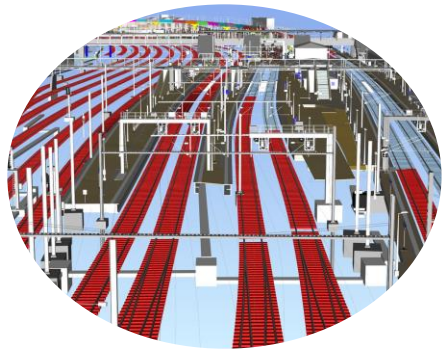
BIM DEPLOYEMENT AT SNCF R

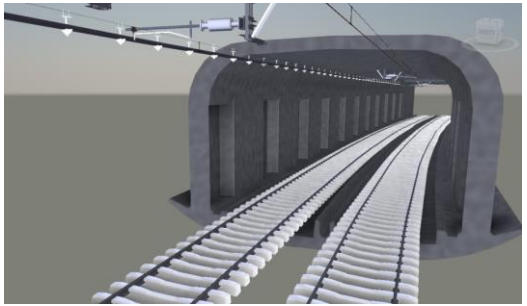
INDUSTRIALIZATION OF BIM ON RAILWAYS DESIGN PROJECTS

Coordination
SIG/CAT

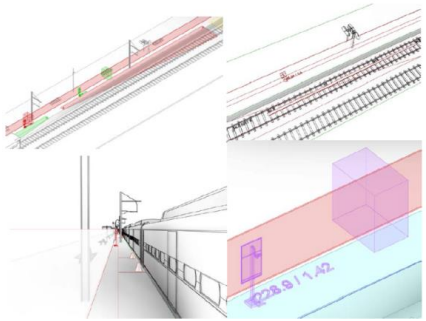




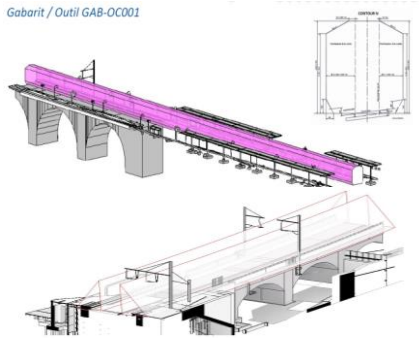
Coordination Track / Assets



Tunnels



Telecom



Requirements management

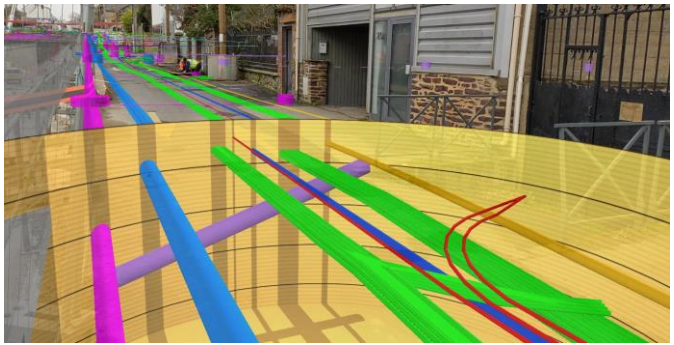
BIM DEPLOYEMENT AT SNCF R

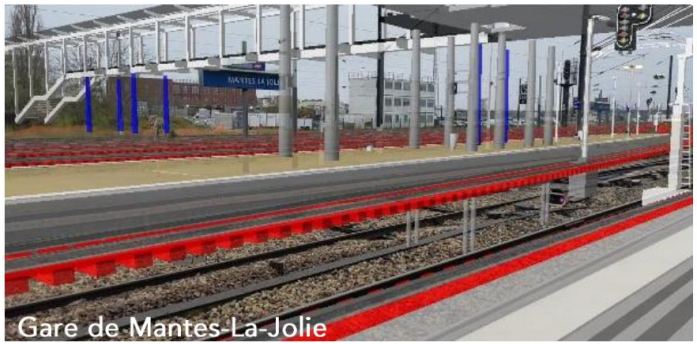
INDUSTRIALIZATION OF BIM ON RAILWAYS CONSTRUCTION PROJECTS

BIM on construction site for Design and Construction.

Deploying emerging technology focus on **BIM2Field use case: Mixte Reality, Augmented Reality**

Develop new use cases on railways operation context





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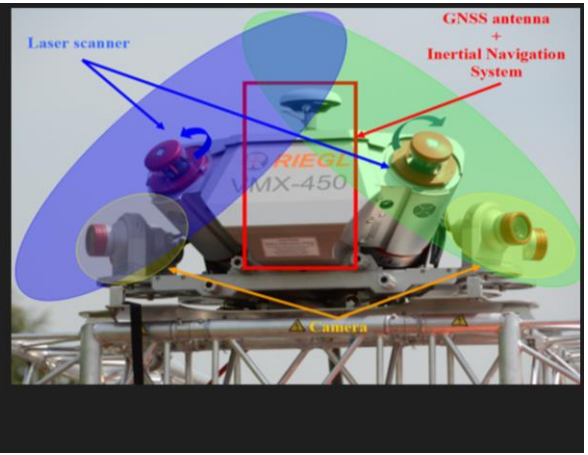
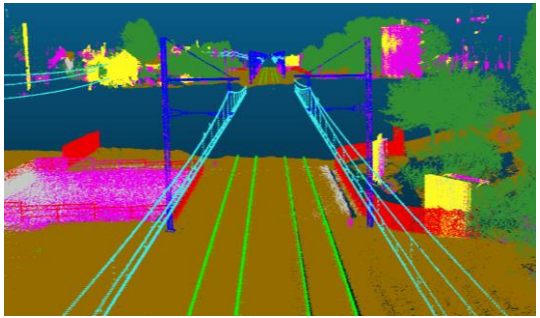
INDUSTRIALIZATION OF BIM ON RAILWAYS PROJECTS : LASER SCANING

Laser scanning





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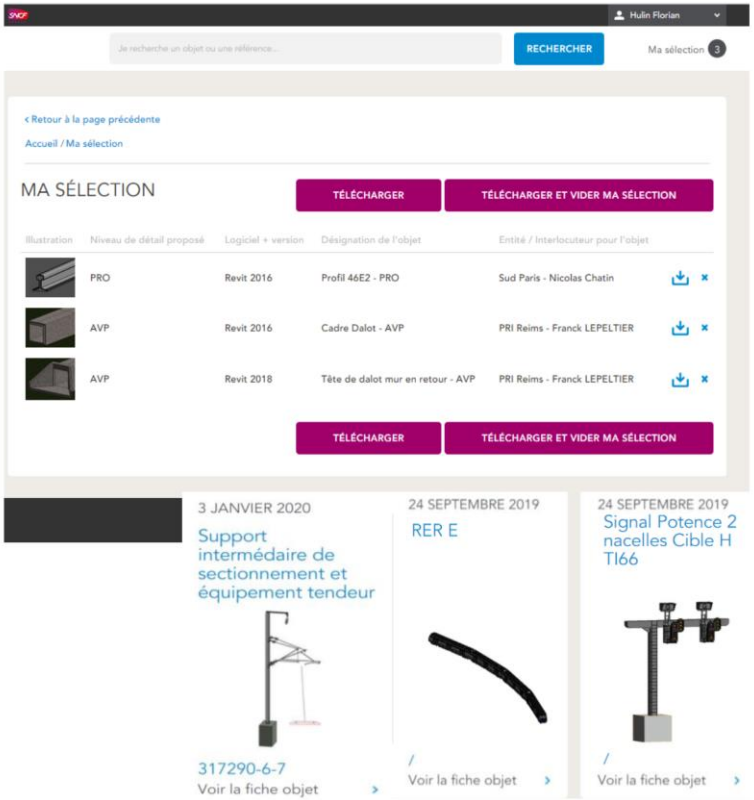
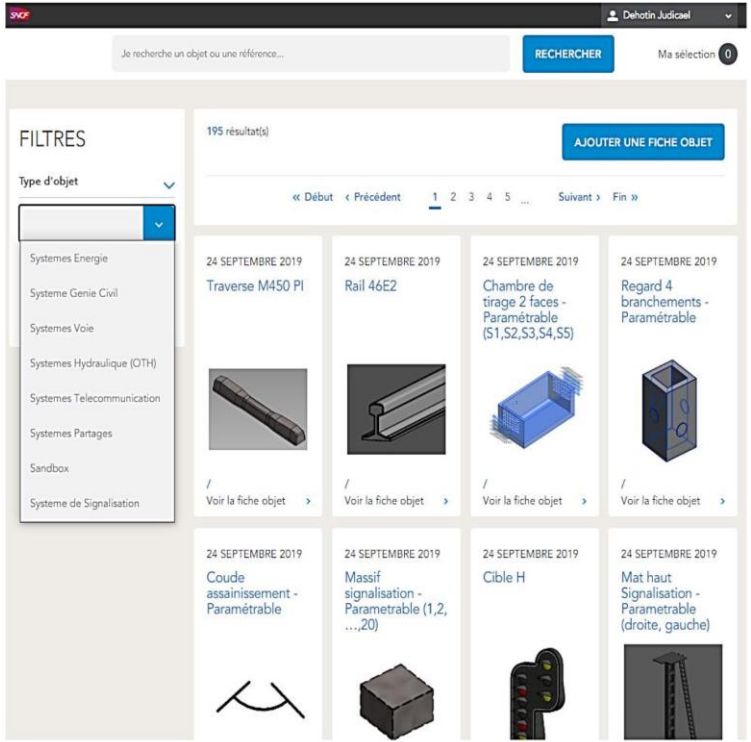
BIM DEPLOYEMENT AT SNCF R

INDUSTRIALIZATION OF BIM ON RAILWAYS PROJECTS : OBJECT LIBRARY





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BIM DEPLOYEMENT AT SNCF R

INDUSTRIALIZATION OF BIM ON RAILWAYS PROJECTS : IFC RAIL (IFC 4.3)

OBJECTIVES: SOFTWARE REQUIREMENT

+Viable interfaces between the different railway areas

+Implementation of railway business requirements to existing IFC mapping

+Implementation of IFC rail by software developers

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BIM AT SNCF RESEAU

BIM DESIGN CONTSRUCTION TO DIGITAL TWIN

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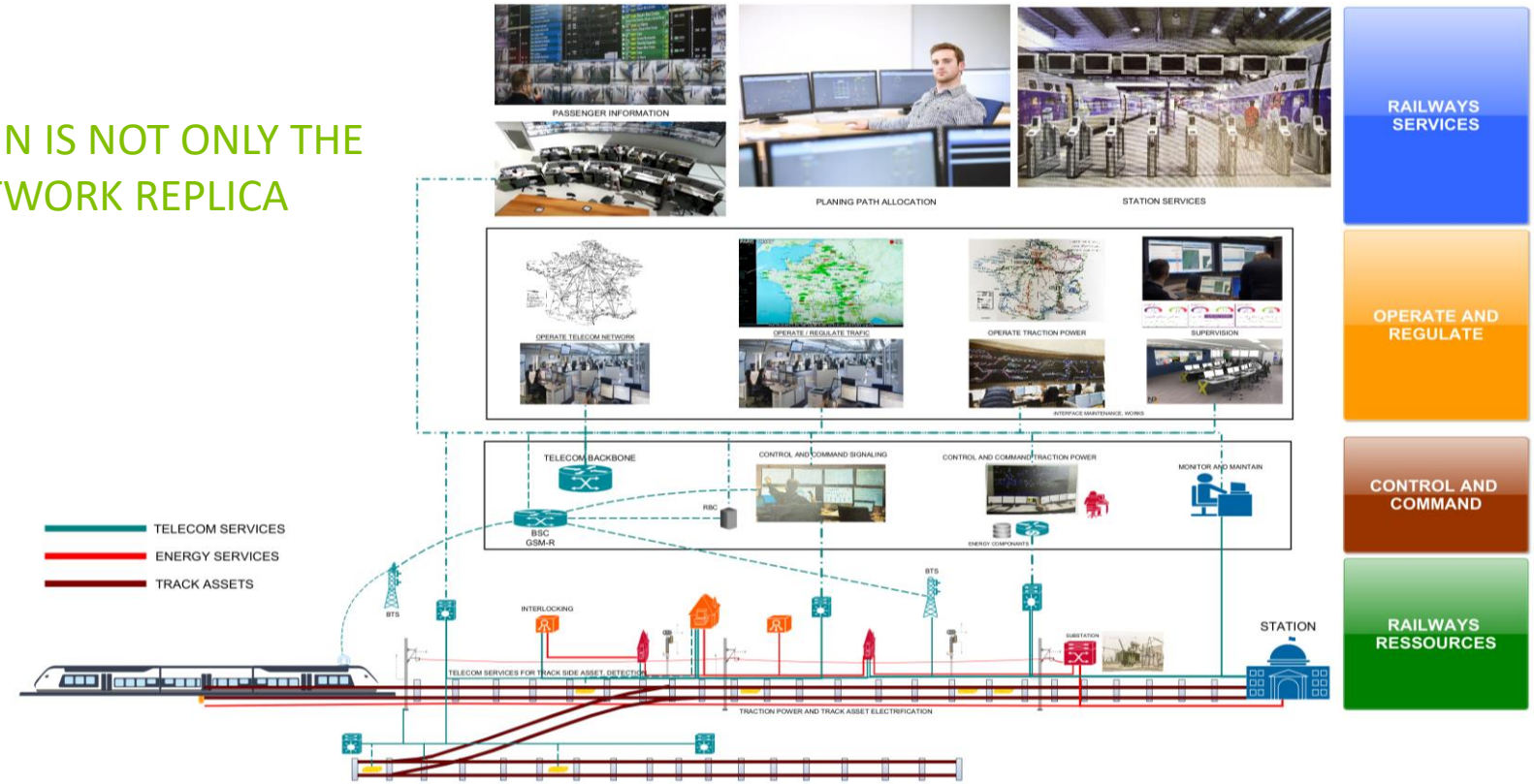
BIM DEPLOYEMENT AT SNCF R

DIGITAL TWIN DYNAMICS

DIGITAL TWIN IS NOT ONLY THE DIGITAL NETWORK REPLICA



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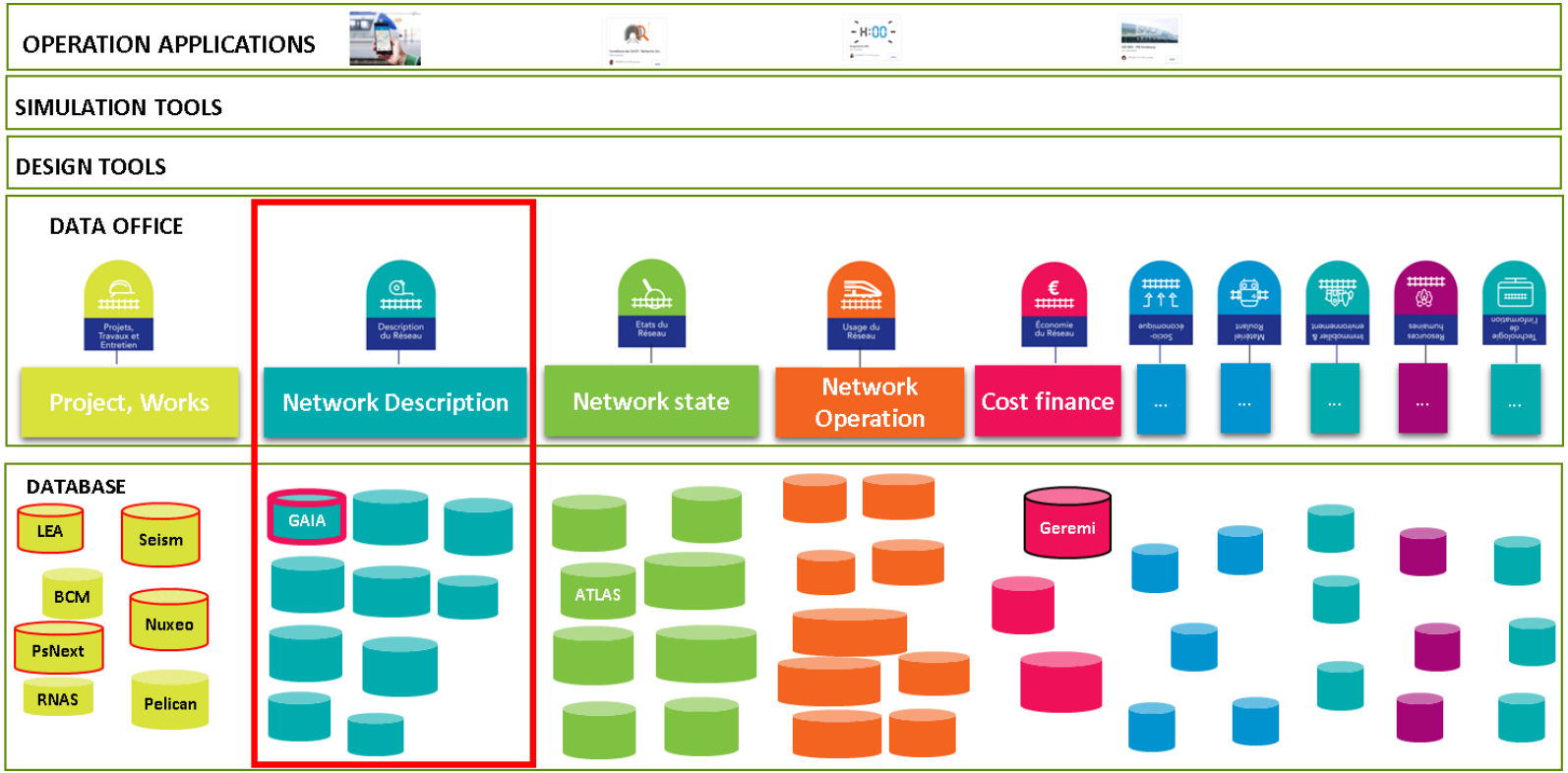
DIGITAL TWIN DYNAMICS : IT LEGACY DATABASES BIG PICTURE



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DIGITAL TWIN DYNAMICS: CONSORTIUM MINERVE: SNCF LEADER IN THE RAILWAY BIM ECOSYSTEM

A STRONG PARTNERSHIP BETWEEN 6 ACTORS: COMPANIES, INSTITUTES, RESEARCH LABORATORIES

« The will to mobilise the rail industry on a digital deployment, throughout the continuous and sustainable life cycle of the infrastructure »

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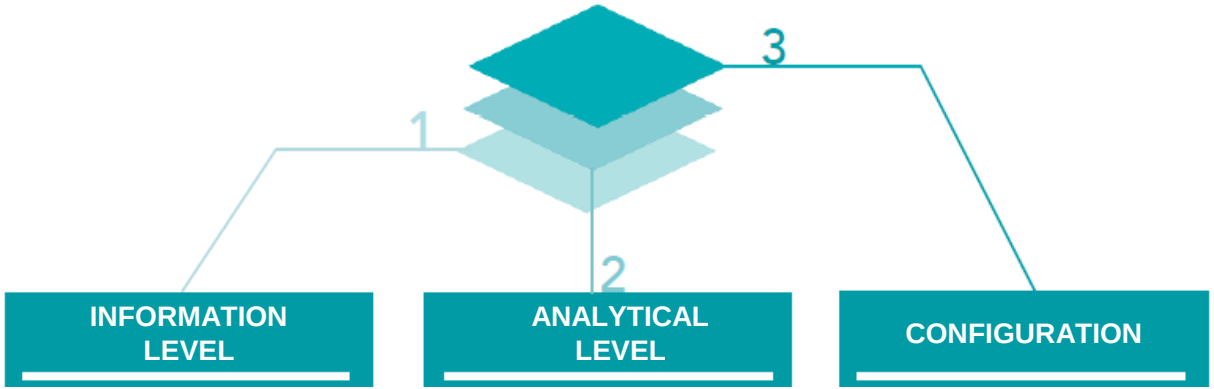
bpifrance

Le projet MINERVE a été financé par le gouvernement dans le cadre du Plan de Relance et du Programme Investissements d'Avenir

BIM DEPLOYEMENT AT SNCF R

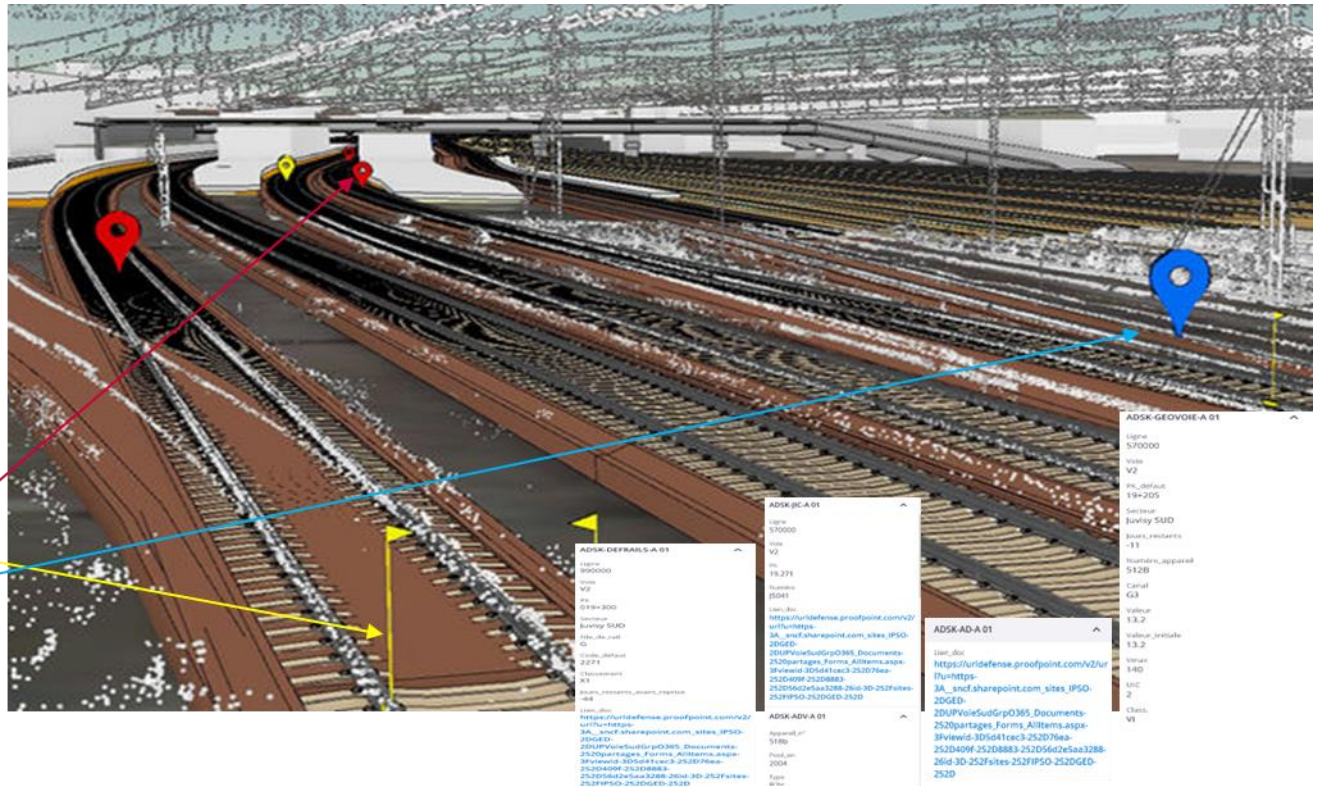
DIGITAL TWIN



BIM DEPLOYEMENT AT SNCF R

DIGITAL TWIN USE CASE DEVELOPEMENT

EXPERIMENT BIM ON TRACK MAINTENANCE ON JUVISY SECTOR



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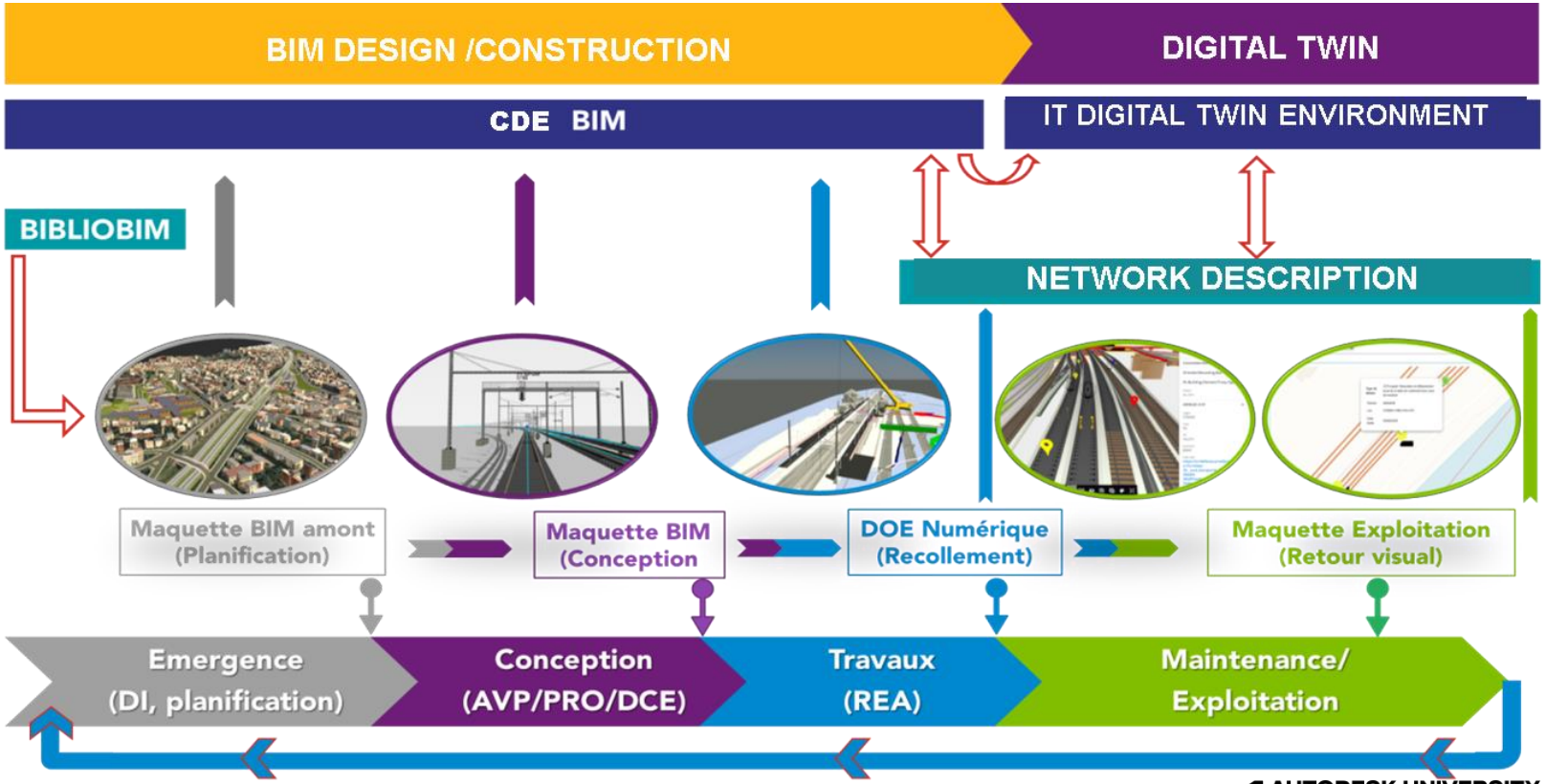
BIM DEPLOYEMENT AT SNCF R

DIGITAL TWIN AND BIM : DIGITAL CONTINUITY



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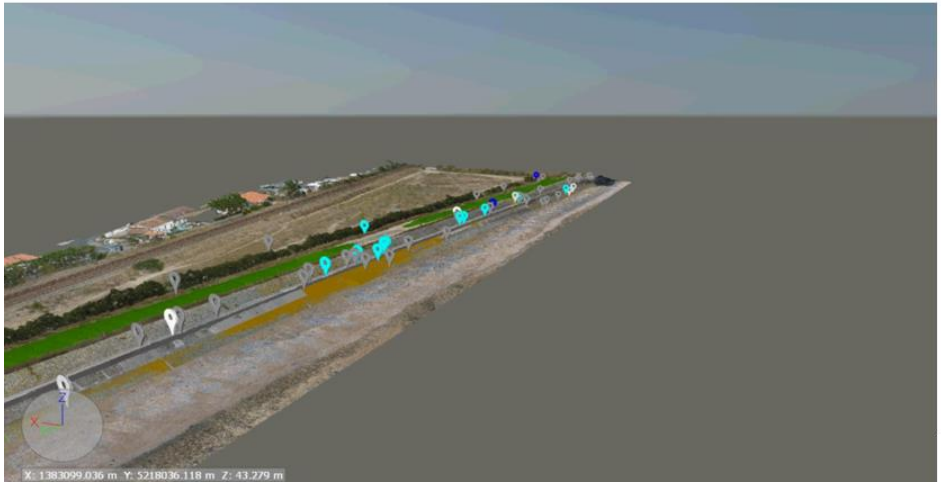
BIM DEPLOYEMENT AT SNCF R

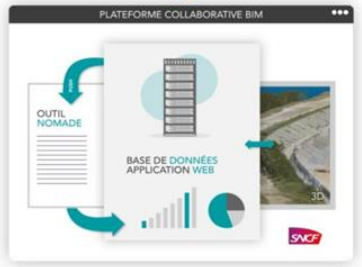
DIGITAL TWIN DIGITAL TWIN USE CASE DEVELOPEMENT

USE case # 2
BIMDigue

À partir d'une
multitude de sources

INSPECTION OF WORKS





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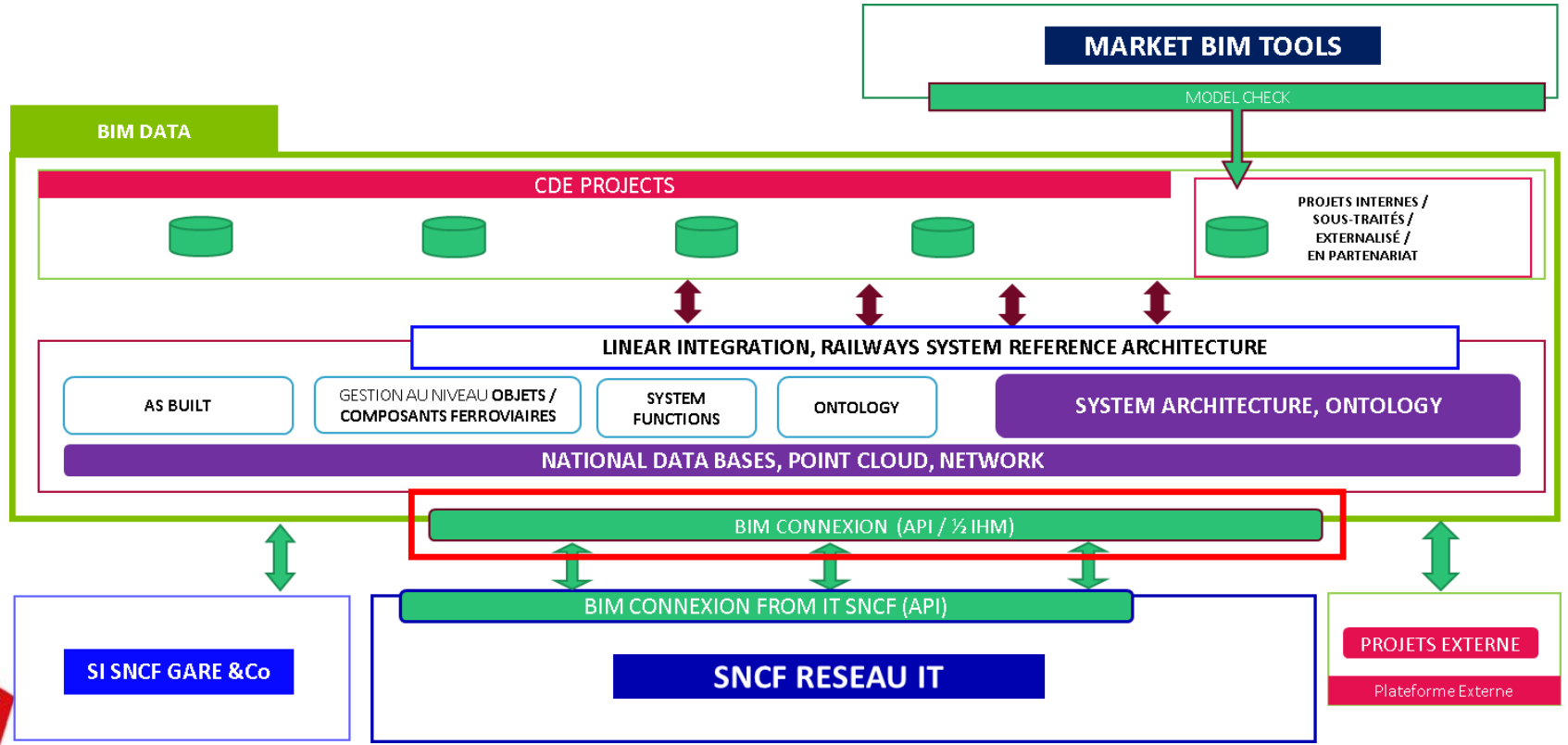
BIM DEPLOYEMENT AT SNCF R

DIGITAL TWIN AND BIM CONTINUITY : BIM AND IT CONNEXION



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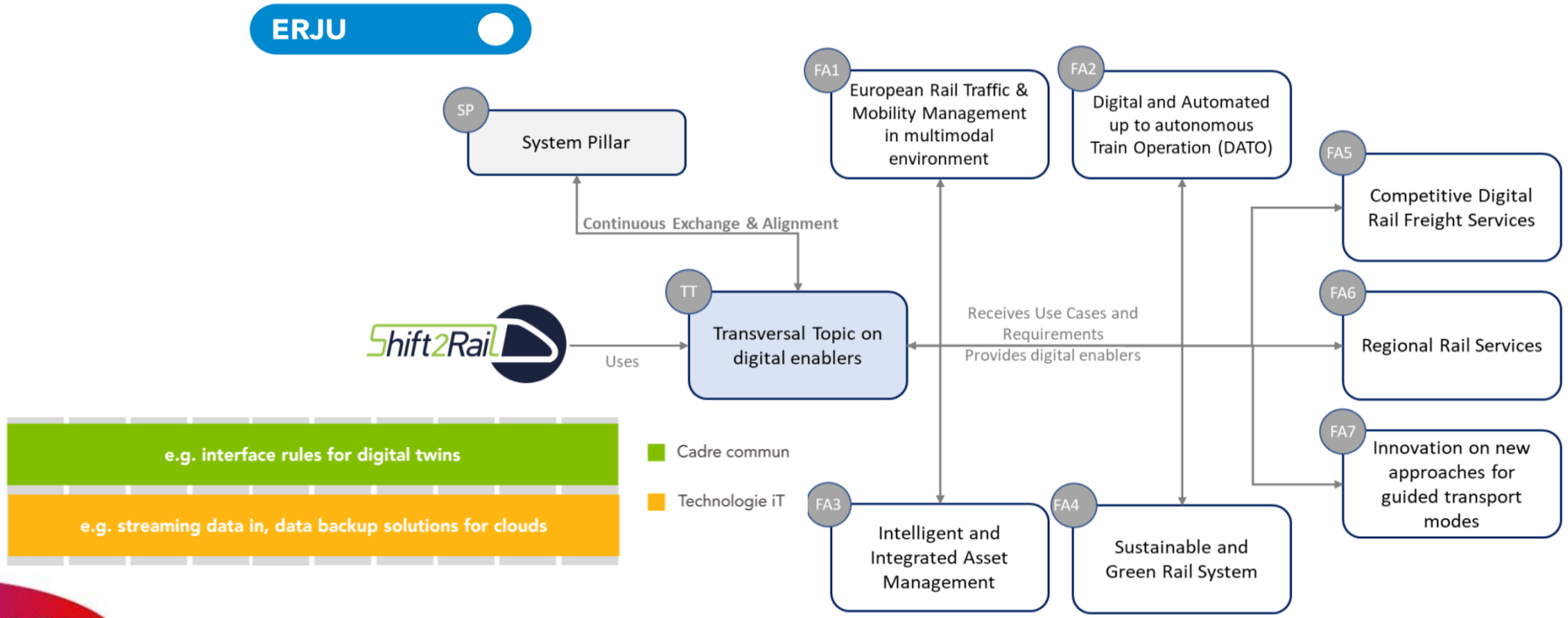
BIM DEPLOYEMENT AT SNCF R

DIGITAL TWIN : SYSTEM PILAR (EU RAIL)



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BIM AT SNCF RESEAU

BIM REQUIREMENT AND IMPACT ON TOOLING BIM

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SNCF RESEAU BIM REQUIREMENT

BIM PRODUCTION REQUIREMENT (NEEDS)

BIM VALUE FOR RAILWAYS PERFORMANCE

Defining BIM Objectives and Uses cases, focused on business Stakes and need

Uses case specific to sub-domain and security issue needed

BIM MANAGEMENT IN RAILWAYS PROJECTS

Integrated railways project management principles and different required milestones

- Public concertation, legacy authorization, components testing…

DESIGN AND CONSTRUCTION PHASES

Focused on Design and construction, but also for system integration

Reduce the complexity of BIM tools focus on business requirement

TOOLS AND DATA STRUCTURE

Right tool for Righ process

Open format for input and output

Transferable information from tools to the legacy system with low cost

EXPECTED BASIC ARCHITECTURE FOR SOFTWARE

Multi format supported

open formats

SNCF RESEAU BIM REQUIREMENT

BIM PRODUCTION REQUIREMENT (REPORT)

BIM VALUE FOR RAILWAYS PERFORMANCE

Too generic BIM Uses cases far from railways performance not focused on railways

BIM “Strategist” are too closed to selling specific solution.

We need to put BIM at the service of user’s needs. We need the right BIM NOT to do the BIM right

BIM MANAGEMENT IN RAILWAYS PROJECTS

BIM is considering as parallel process by Railways specialist to their process and working methods.

We need to **promote railway processes (which go further than the construction of structures)...**

TOOLS FOR DESIGN AND CONSTRUCTION

BIM Design **tool are not specific to railways sub-domain** and our experts spent **many time to adapts existing tools**. **A Lots of intermediate tools** to fix issues that should have been done otherwise in the main tools.

We **need specific tools for railways design to create suitable models**. We need more engineering and Rail data in BIM Model.

DATA STRUCTURE IN TOOLS

Many tools have their own dedicated data pre-processing, regardless to the common existing common data structure. **Many specific and non-open data format are required and provided. This introduce digital discontinuity** since the process and data flow need to be use in several tools.

Input and output data should use open format to contribute to system integration

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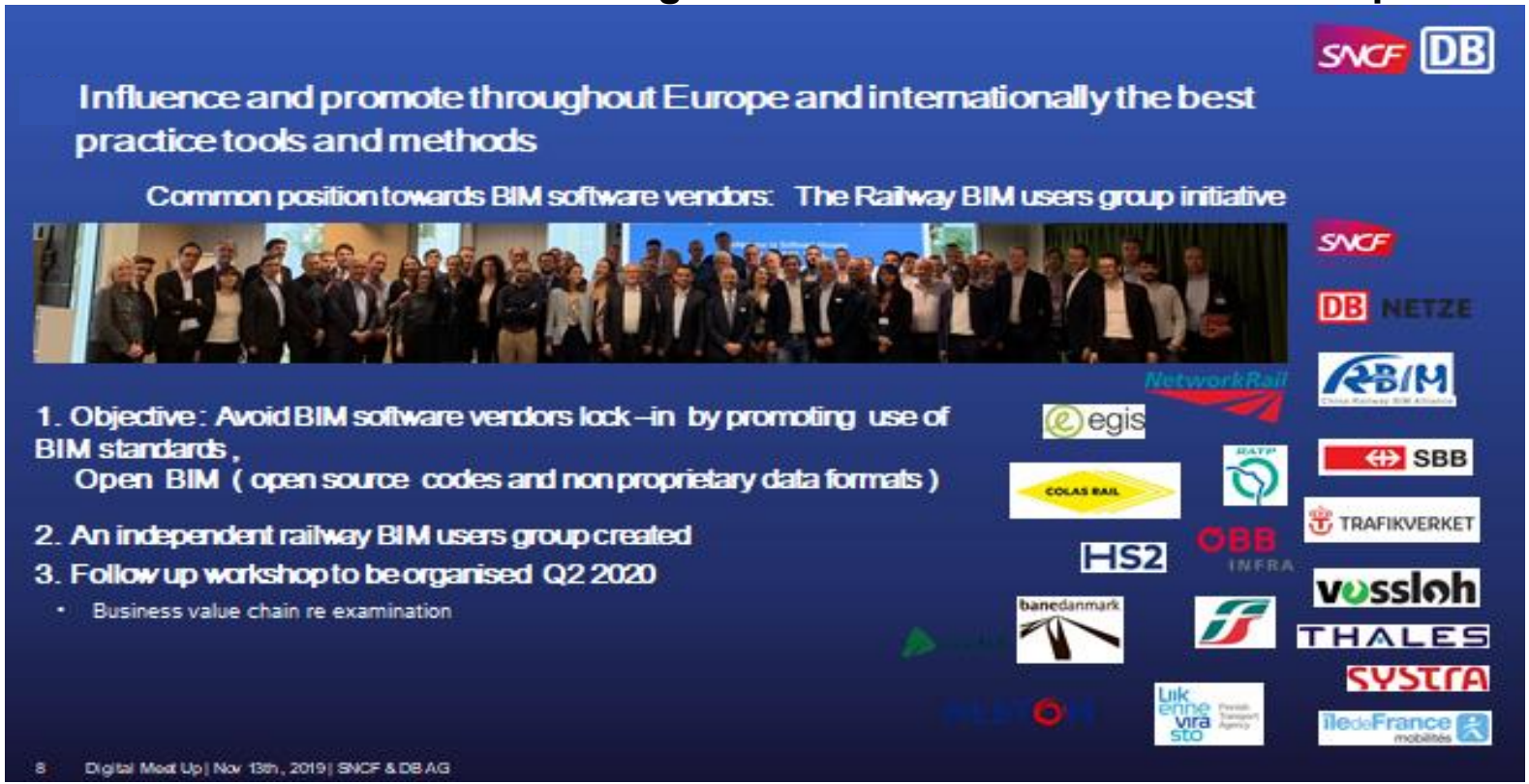
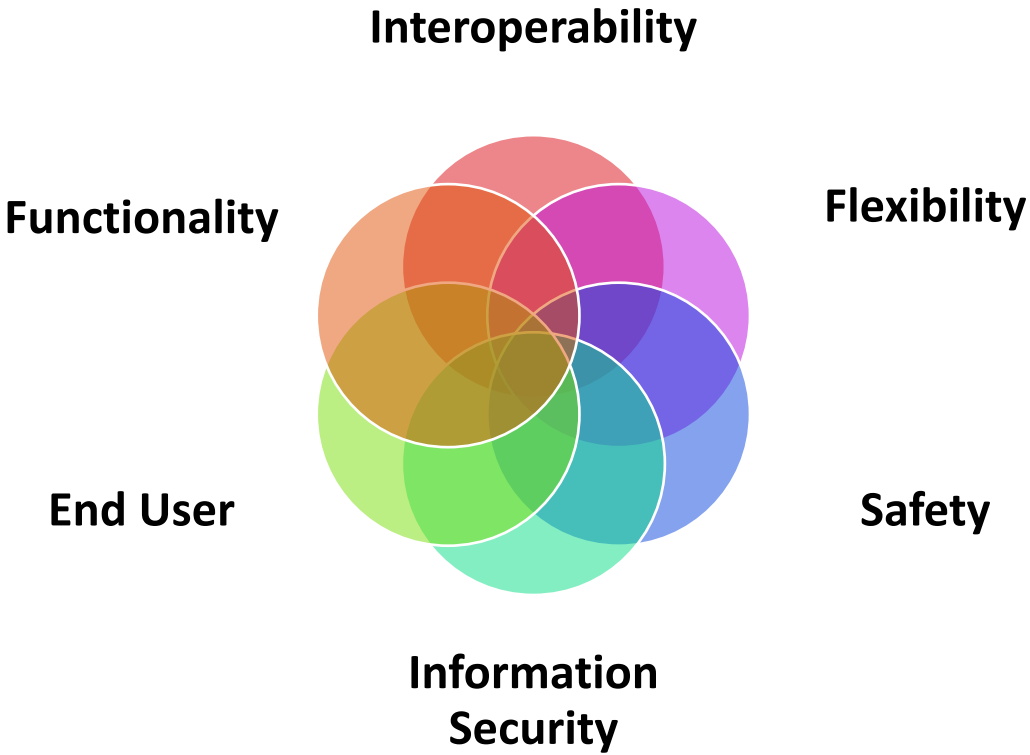
SNCF RESEAU BIM REQUIREMENT

Railways BIM User's GROUP: Promote Dialog between stakeholder and solution provider



SNCF RESEAU BIM REQUIREMENT

Railways BIM User's GROUP: Promote Dialog between stakeholder and solution provider



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SNCF RESEAU BIM REQUIREMENT

RAILWAYS BIM USER'S GROUP

- **Management of data through** the full asset lifecycle, including robust change and configuration management
- **API-based connectors to common business systems** including, but not limited to ERP systems (Oracle, SAP etc.)
- **Automated modelling from new and existing data sets,** including the ability to generate **documentation** from the output (e.g. from the 3D model). Computer vision should also be utilised for asset recognition.
- **Handle specific needs of Railways** (linear/non-linear, long distances, integration of all disciplines, organisation-specific chainage and coordinate and **linear referencing systems**
- **Master data management**, for example around the PBS/ABS for procurement activities
- **Simulate various scenarios such as constructability**; cost; carbon build up; pedestrian flow etc. using the Digital Twin during design, construction and operations
- Streamline assurance activities using data to validate and **verify requirements through the V Cycle**.

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THANKS