AUTODESK UNIVERSITY

SNCF RÉSEAU

# BIM in SNCFR Digital Transformation:

TR501801

PhD JUDICAEL DEHOTIN
Deputy Director Sncf Reseau BIM program

# ABOUT ME

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.
Representative of Infrastructure manager in the EU program *Europe 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.

SNCF RÉSEAU

# Learning Objectives

1. **Introduce Railways issues** and how BIM technologies can help
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

SNCF RÉSEAU

AUTODESK UNIVERSITY

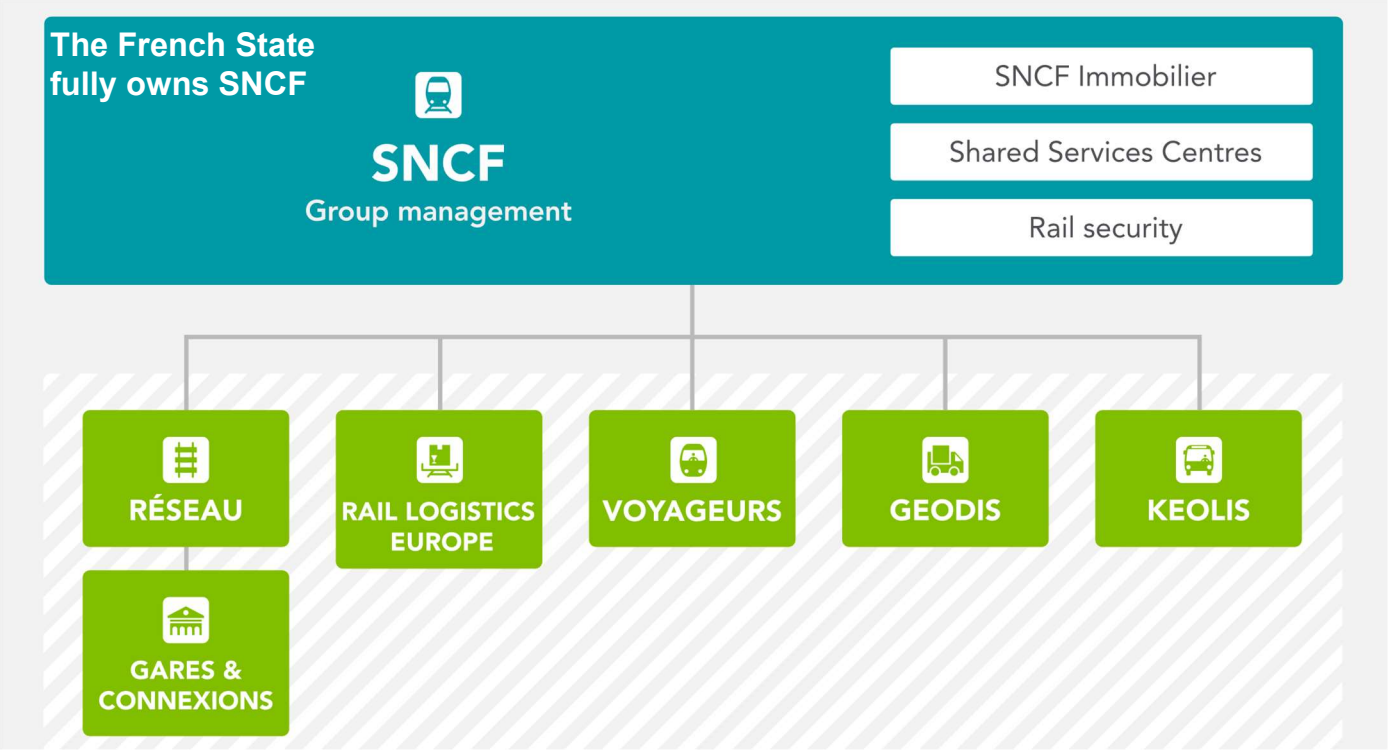
AUTODESK UNIVERSITY

# SNCF RESEAU IN A NUTSHELL

FRENCH RAILWAYS INFRASTRUCTURE MANAGER

SNCF RÉSEAU

# 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

SNCF RÉSEAU

EUROSTAR™ Paris - London

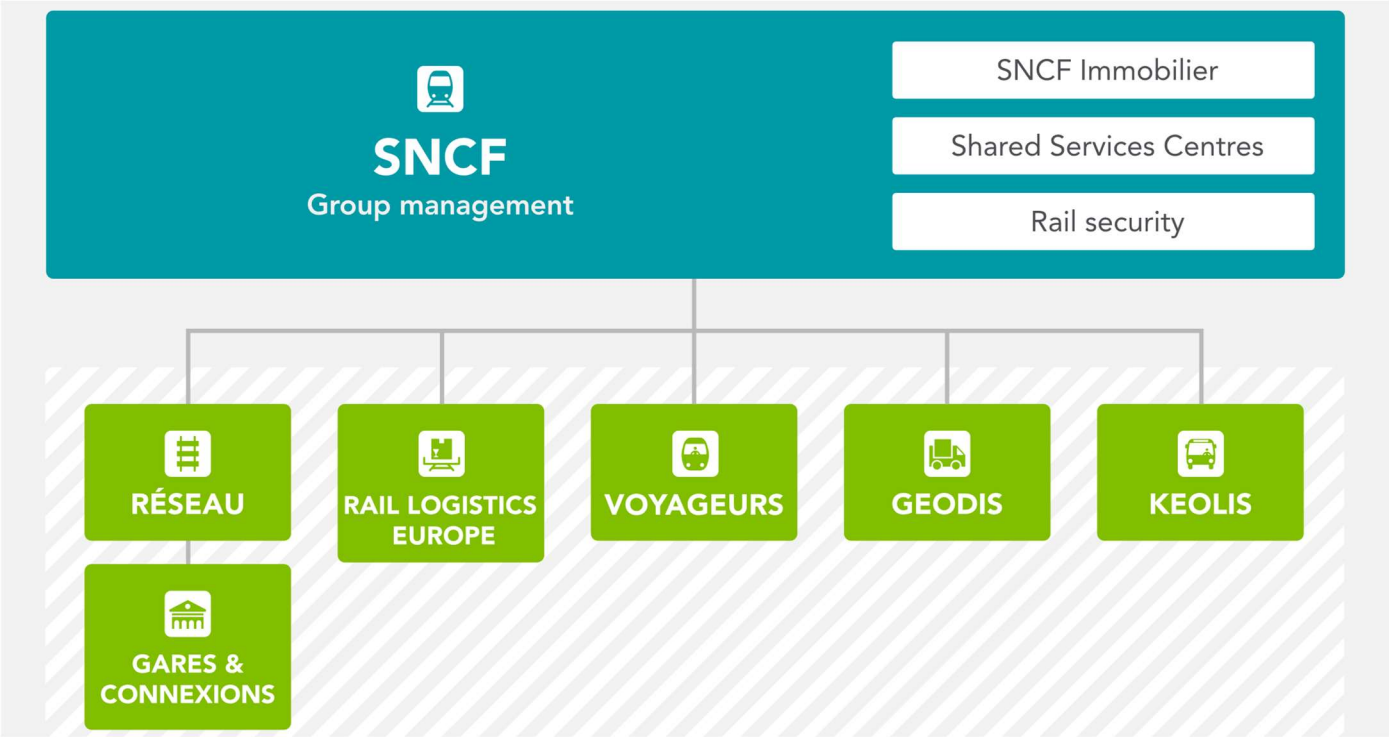
THALYS Paris - Brussels - Amsterdam

GEODIS Multimodal freight & freight forwarding

KEOLIS World leader in day to day mobility

RAIL LOGISTICS EUROPE Rail Freight Transport & logistics

# SNCF RESEAU : A SNCF GROUP COMPANY




**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

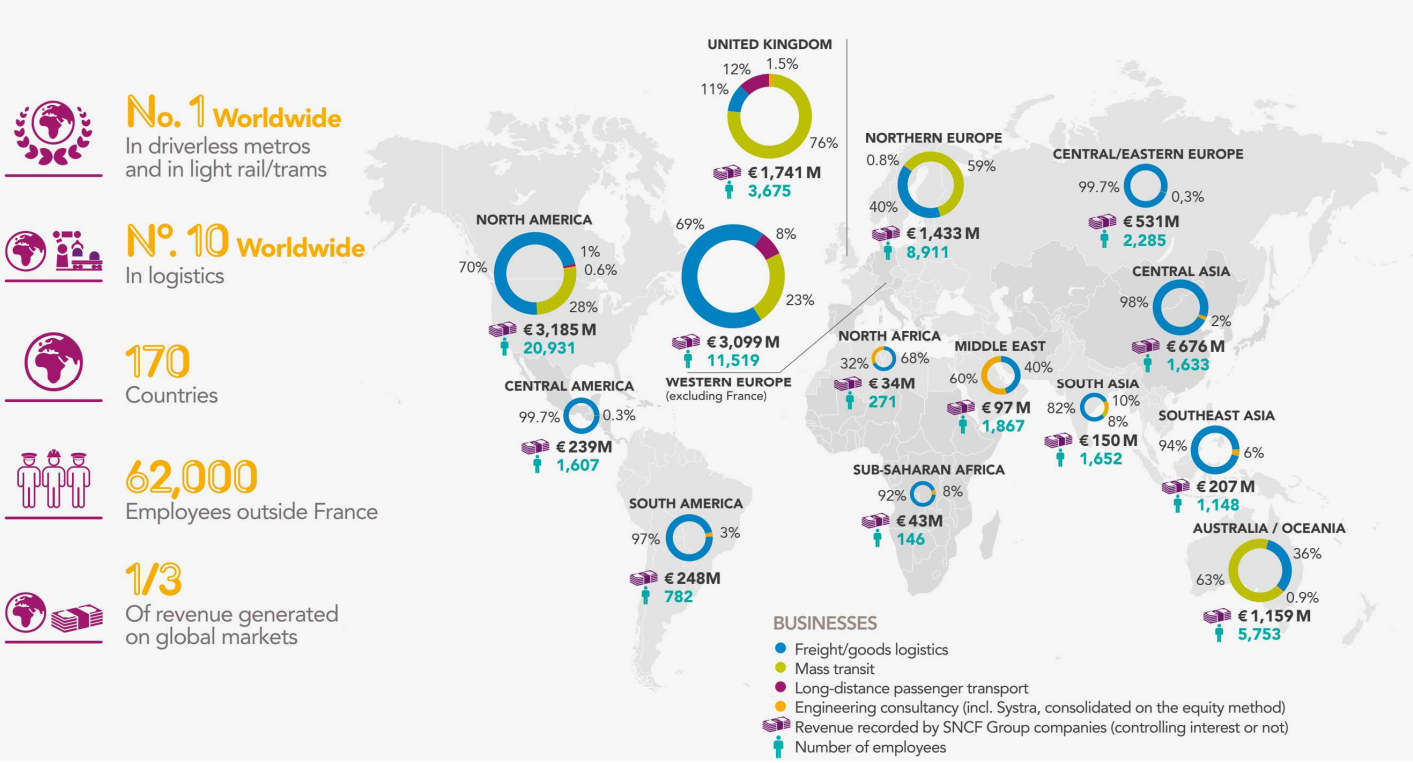
**Geodis specializes in freight** transport logistics in France and 120 countries worldwide.

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


SNCF RÉSEAU

AUTODESK UNIVERSITY

# SNCF RESEAU : SNCF GROUP COMPANY




**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

SNCF RÉSEAU

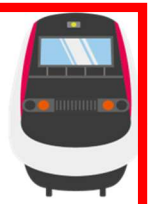

AUTODESK UNIVERSITY

# 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



SNCF RÉSEAU

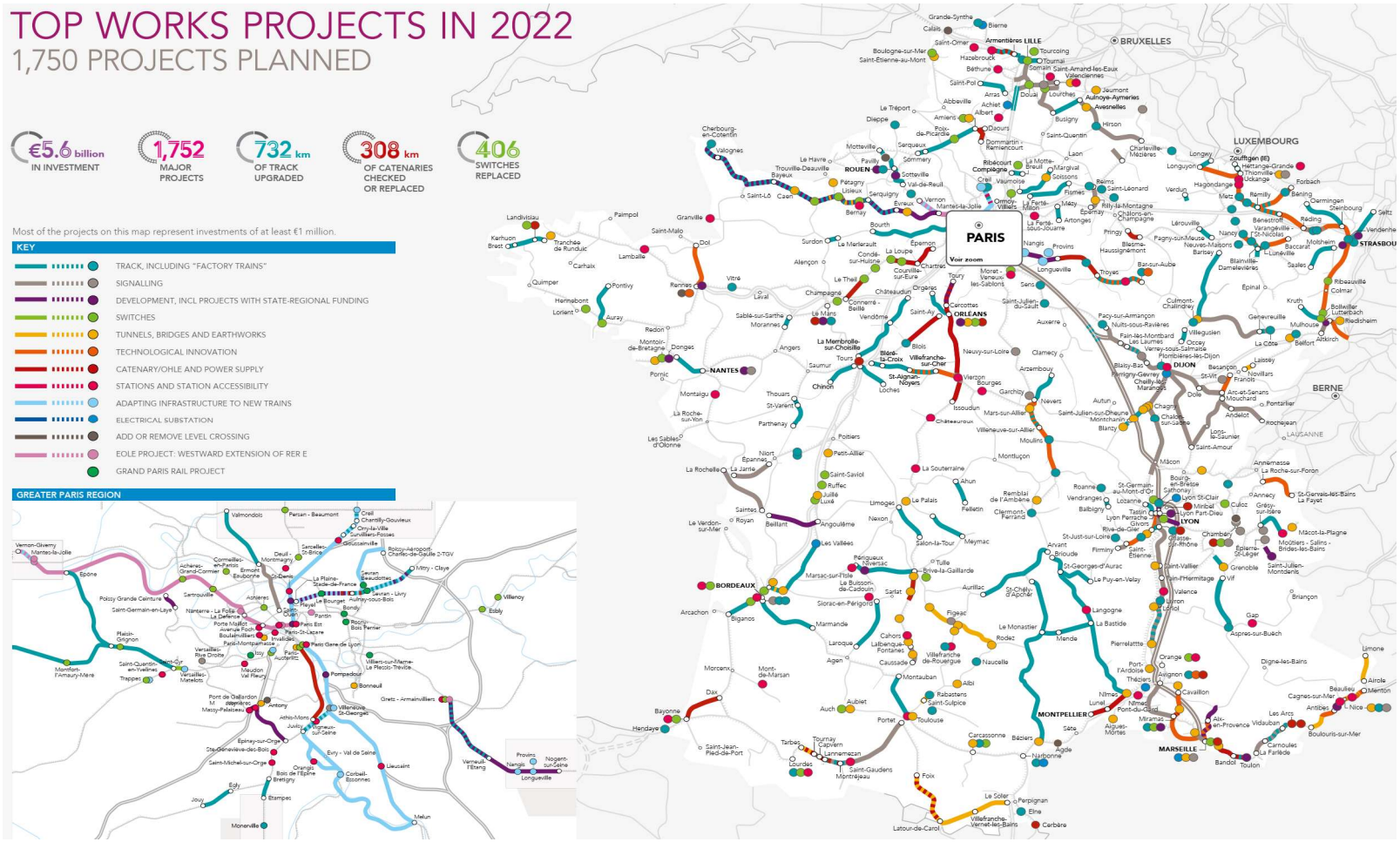
## SNCF RÉSEAU OWN FRENCH RAILWAYS NETWORK

# 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**




SNCF RÉSEAU

AUTODESK UNIVERSITY

# SNCF RESEAU ACTIVITIES

## RAILWAYS INFRASTRUCTURE MANAGEMENT FROM DESIGN TO OPERATION

- RAILWAYS **NETWORK SERVICES** FOR RAILWAYS UNDERTAKING
  - ACCES TO NETWORK : 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

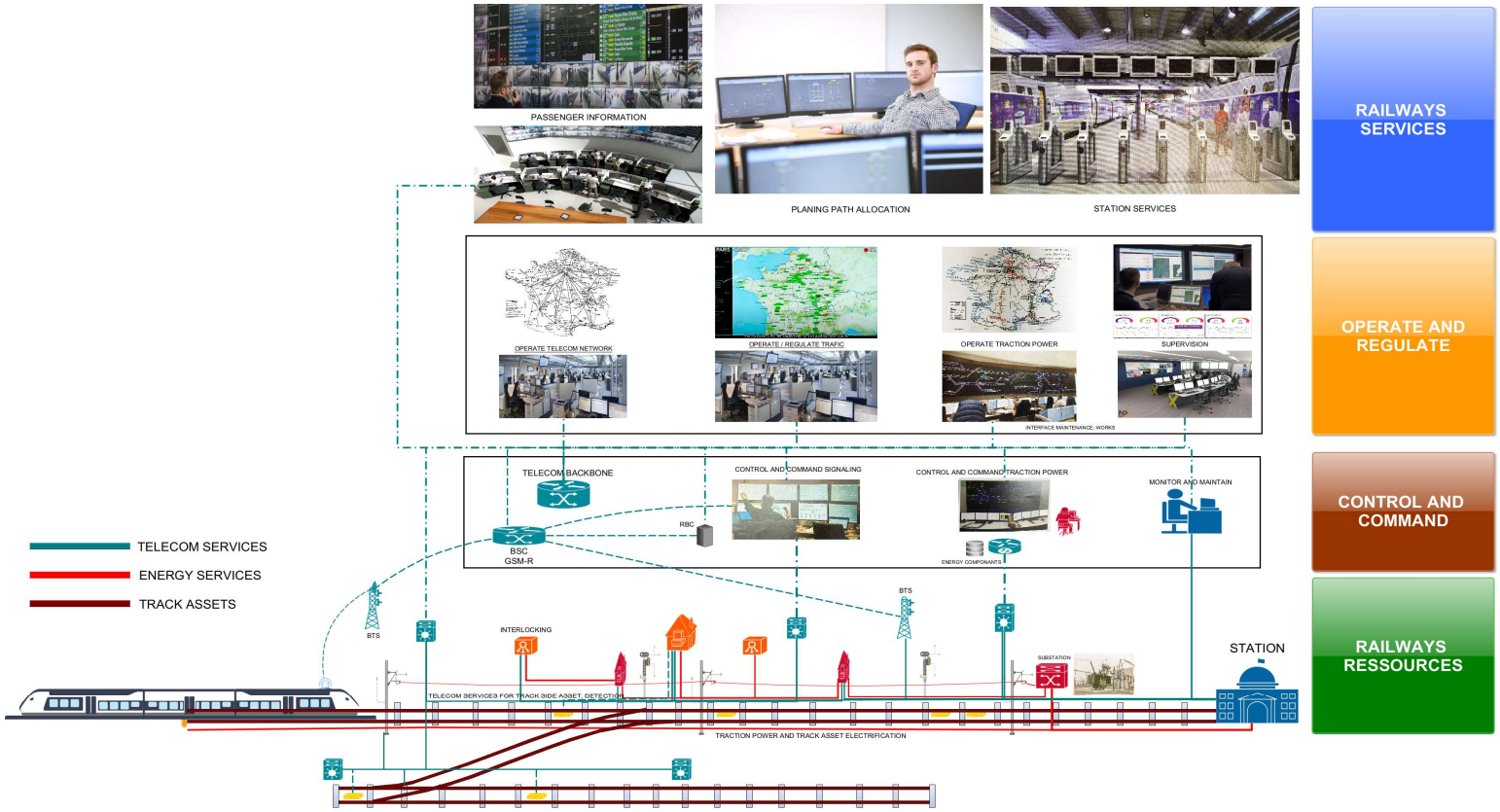
SNCF RÉSEAU

# SNCF RESEAU ACTIVITIES

## RAILWAYS INFRASTRUCTURE MANAGEMENT FROM DESIGN TO OPERATION

RAILWAYS INFRASTRUCTURE SUB-SYSTEM : INTEGRATED MULTI DOMAIN ENGENIERING

**CONTROL COMMAND**
**TRACK**
**ENERGY**
**TELECOM**
**SIGNALING**
**CIVIL WORKS**




SNCF RÉSEAU

AUTODESK UNIVERSITY

# SNCF RESEAU ACTIVITIES

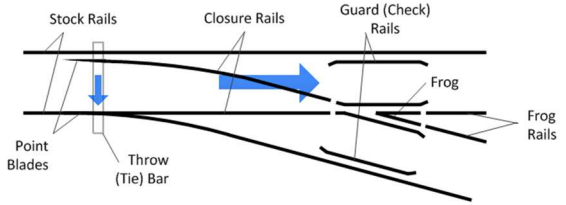
## RAILWAYS INFRASTRUCTURE MANAGEMENT FROM DESIGN TO OPERATION

### RAILWAYS SYSTEM ENGENIERING/INTEGRATION

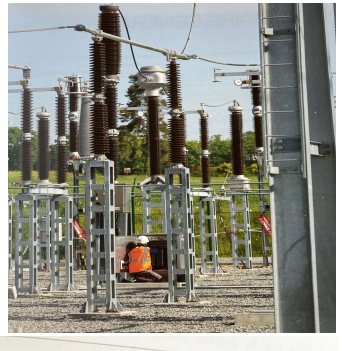
- TRACK SUBSYSTEM
- ENERGY SUBSYSTEM
- TELECOM SUBSYSTEM
- SIGNALING SUB SYSTEM
- CIVIL WORKS

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

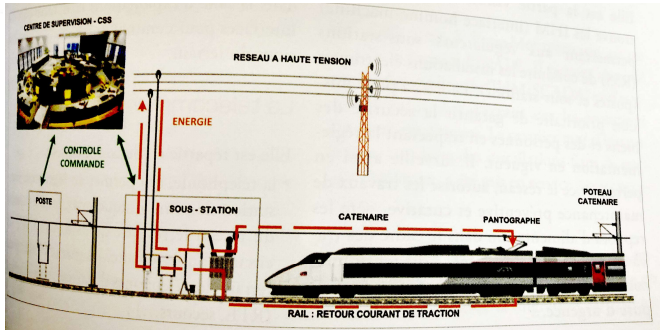
TRACK

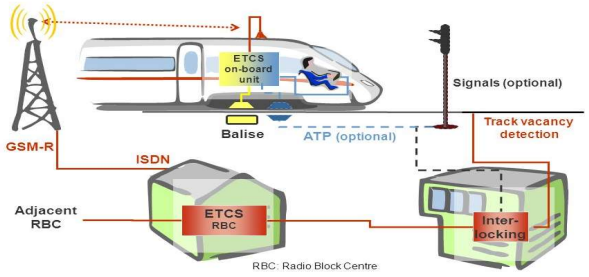


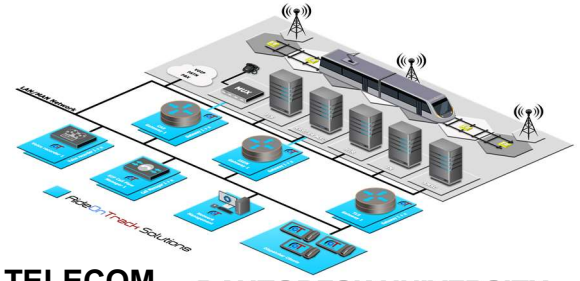

TRACTION POWER



SIGNALING



TELECOM

AUTODESK UNIVERSITY

SNCF RÉSEAU

# SNCF RESEAU ACTIVITIES

## RAILWAYS INFRASTRUCTURE MANAGEMENT FROM DESIGN TO OPERATION

### RAILWAYS SYSTEM ENGENIERING/INTEGRATION

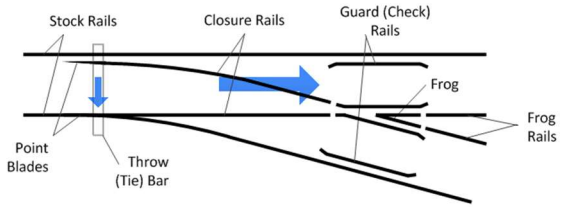
**the regulatory context is quite restrictive due to the risks for the safety of people**

**A distinction is made between**

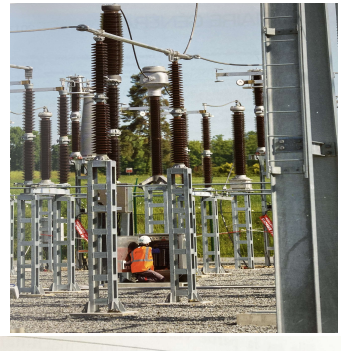
- **local authorities** ➔ local infrastructure developments,
- At national level **transport authorities** as well as **railway safety authorities.**
- **At the European level** there are also rules for transport between countries.

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**

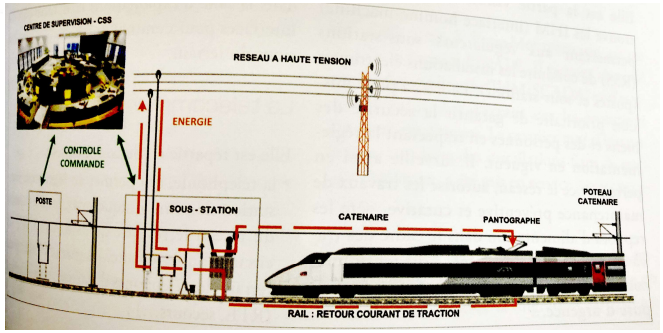
**TRACK**

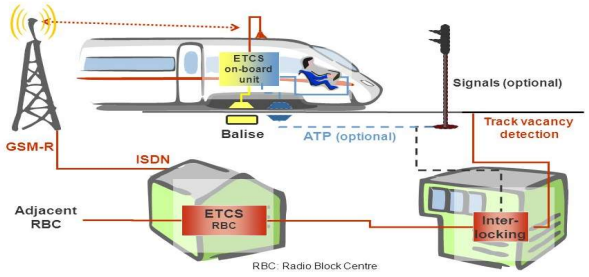


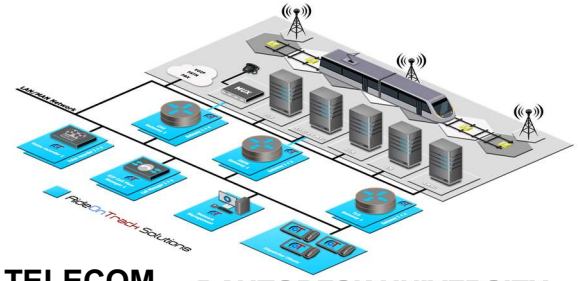

**TRACTION POWER**



**SIGNALING**



**TELECOM** **AUTODESK UNIVERSITY**

SNCF RÉSEAU

# 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**

SNCF RÉSEAU

AUTODESK UNIVERSITY

# 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.**

SNCF RÉSEAU

# SNCF RESEAU ACTIVITIES

## RAILWAYS INFRASTRUCTURE NEED MULTI DOMAIN COORDINATION

### OUR BILIEFS FOR BIM DEPLOYEMENT

- INTEROPERABILITY OF BIM MODELS FOR DIGITAL CONTINUITY OVER THE ENTIRE 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**

SNCF RÉSEAU

AUTODESK UNIVERSITY

# OVERVIEW ON BIM DEPLOYEMENT AT SNCF R

SNCF BIM PROGRAM

# BIM DEPLOYEMENT AT SNCF R

## The Reason for existence: Why BIM Program ?

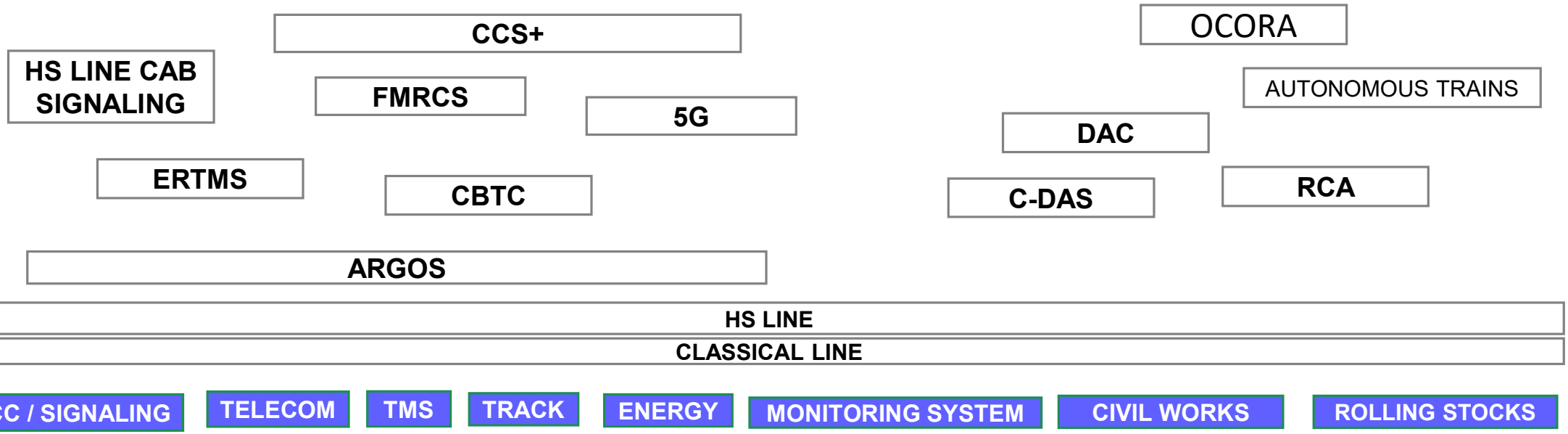
The purpose of the BIM and digital continuity program is to accelerate the digitalization of the design, construction, maintenance and operation of the railways system.

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

SNCF RÉSEAU

# BIM DEPLOYEMENT AT SNCF R

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



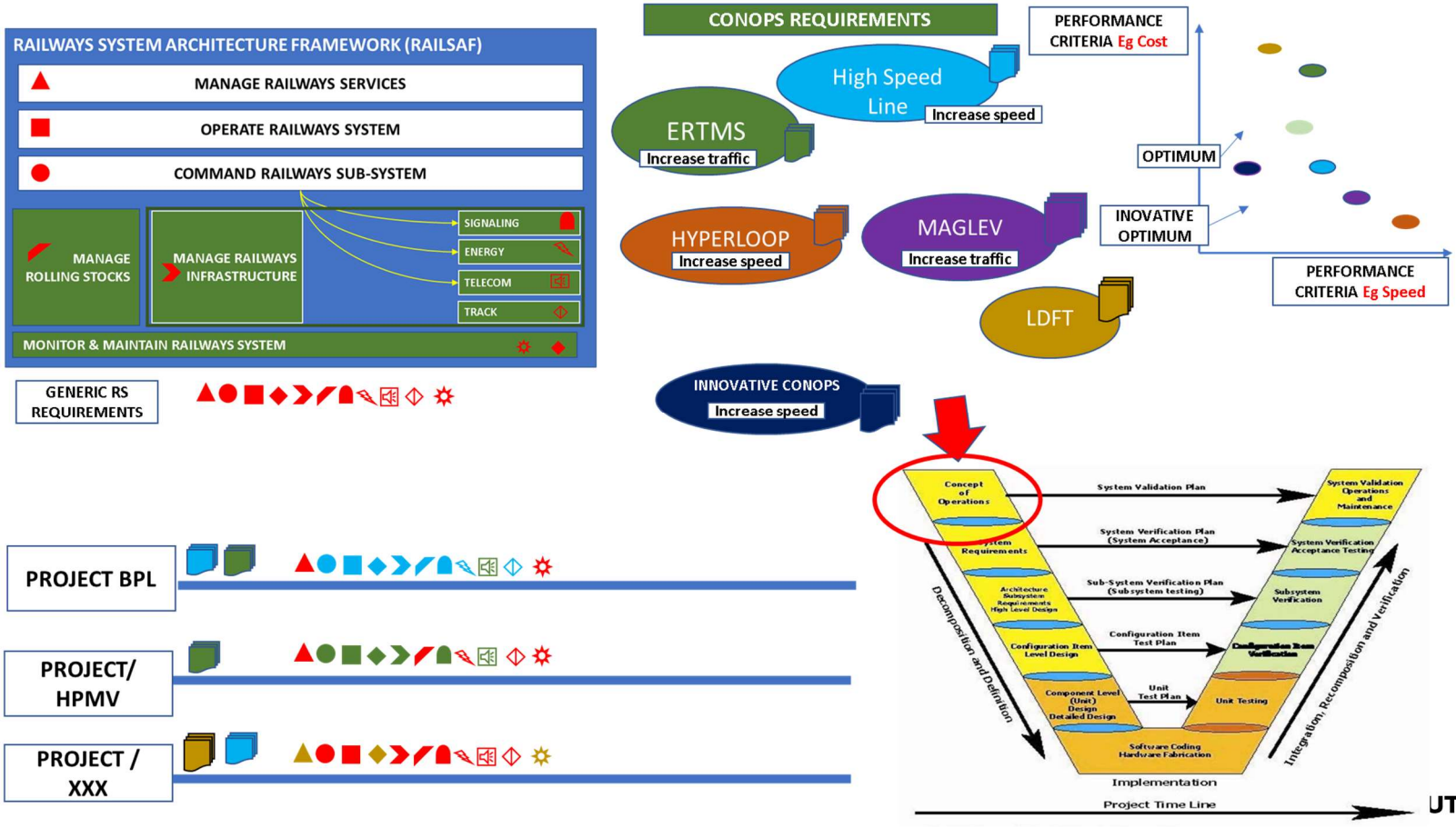

- MULTIPLE REQUIREMENTS, IN EXTENTION OF RAILWAYS BASIC REQUIREMENTS
- EACH IM IMPLENTS DIFFERENTS CONCETPS REGARDING PROJECTS OBJECTIFS
- HOW TO HAVE CONTROL ON GLOBAL PERFORMANCE OR TO CONTROL COLLECTIVE PERFORMANCE AT EU SCALE ?

SNCF RÉSEAU

# BIM DEPLOYEMENT AT SNCF R

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

### RAILWAYS SYSTEM ENGENIERING /INTEGRATION




SNCF RÉSEAU

AUTODESK UNIVERSITY

# BIM DEPLOYEMENT AT SNCF R

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

**RAILWAYS SYSTEM ENGENIERING /INTERGRATION**

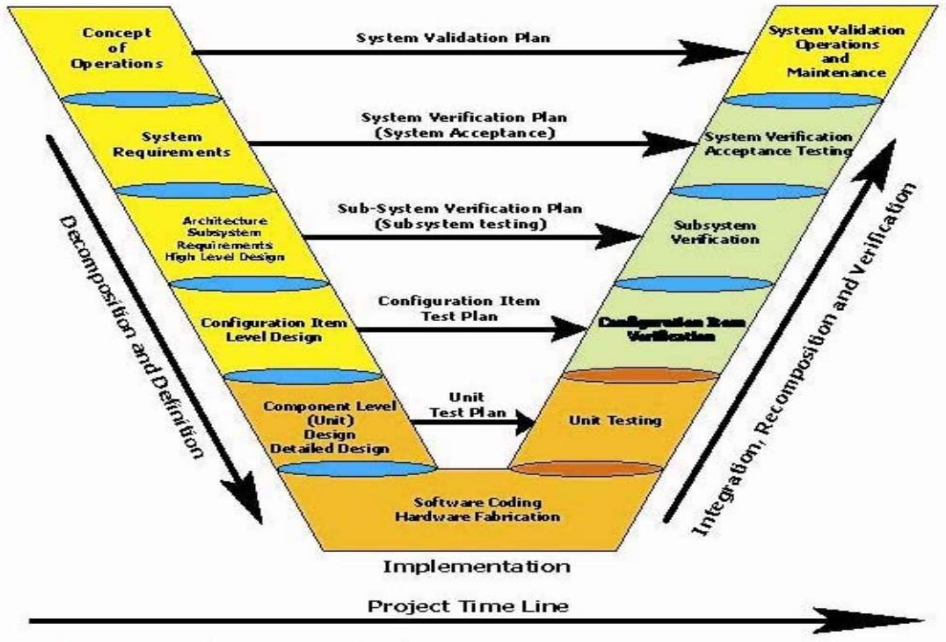
**MAJOR ISSUE IS SYSTEM INTEGRATION**

**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**



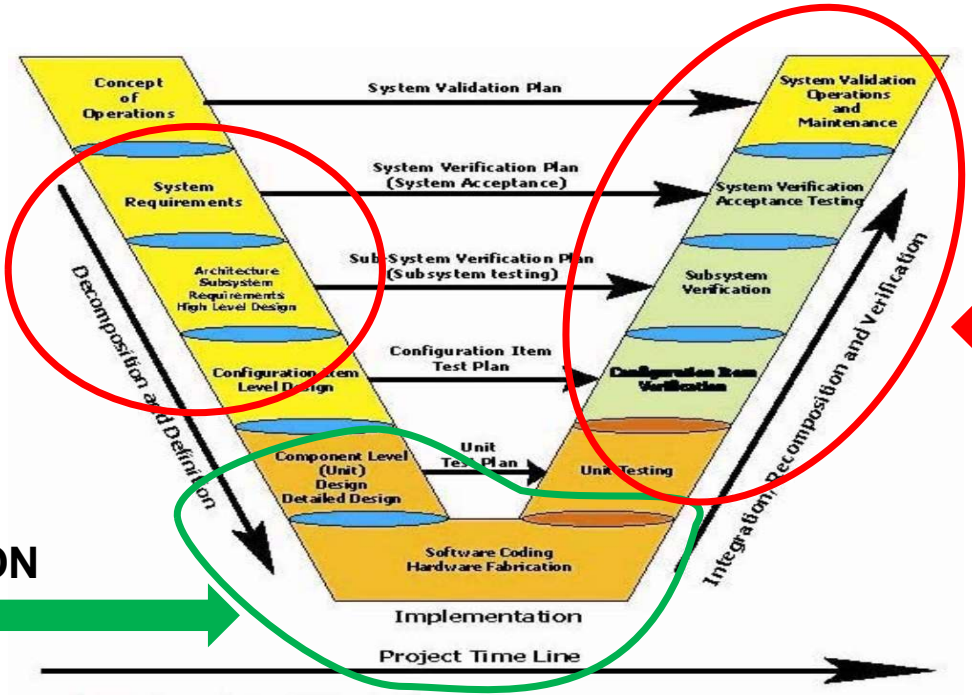

**Integrate software, data, electronics, civil works, hardware, process, "Humanware" , through hundreds of miles**

# BIM DEPLOYEMENT AT SNCF R

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

### RAILWAYS SYSTEM ENGENIERING /INTERGRATION

**EARLY PHASE**
**NO relevant BIM Tools**




**FROM TEST TO VALIDATION PHASE**
**Very Few relevant BIM Tools**

**DESIGN / CONSTRUCTION**

**BIM DO NOT HANDLE THE MAJOR ASPECT OF THE V CYCLE !**

SNCF RÉSEAU

AUTODESK UNIVERSITY

# 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

SNCF RÉSEAU

# BIM DEPLOYEMENT AT SNCF R

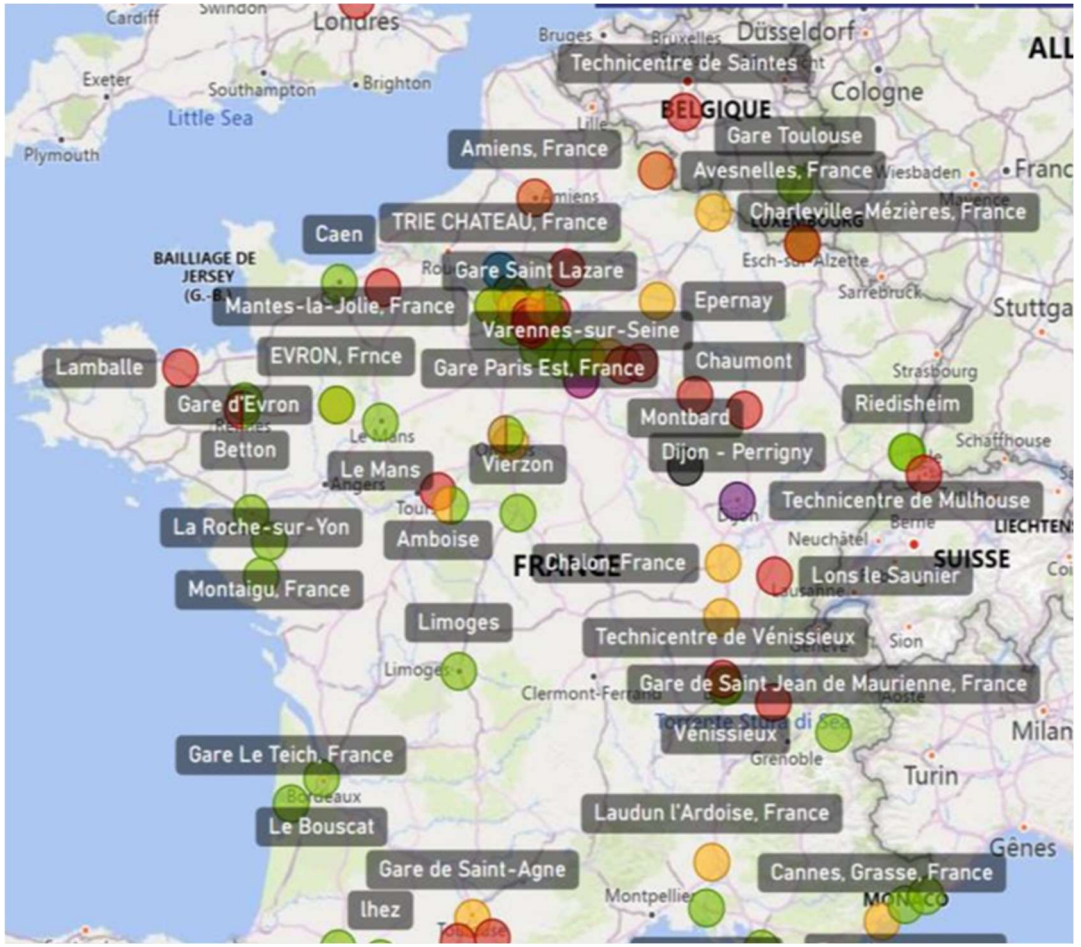
## INDUSTRIALIZATION OF BIM FOR DESIGN/CONSTRUCTION PROJECTS

### 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




SNCF RÉSEAU

AUTODESK UNIVERSITY

# BIM DEPLOYEMENT AT SNCF R

## INDUSTRIALIZATION OF BIM ON RAILWAYS DESIGN/CONSTRUCTION PROJECTS

Main BIM use cases implemented and documented

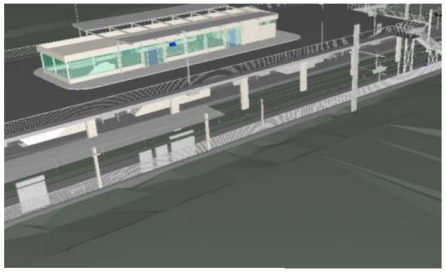
- Platform
- Telecom
- Signaling
- Energy
- Track...

Several uses case were developed with Autodesk


**SDA gare de Paris Est**

Multi Métiers - Multi sites

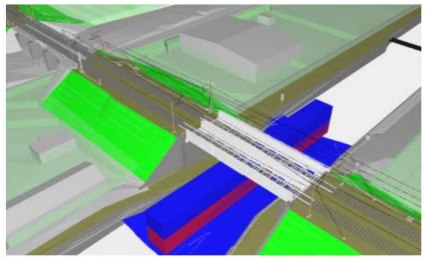
Coordination BIM (PRI/AREP); Phasage 4D



**ORLY RUNGIS gare TGV**

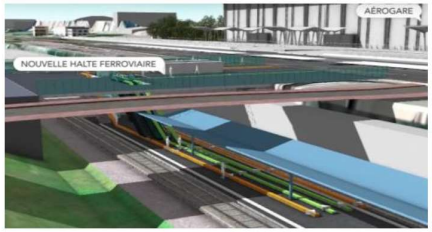
Multi Métiers - Multi sites

Coordination BIM (INGEROP/AREP); Phasage 4D.

**Remplacement de tableriers PRA de Riedisheim**

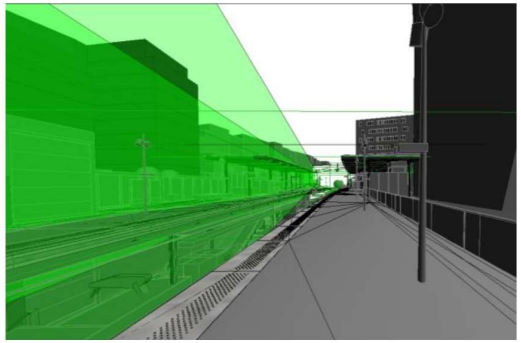
Métiers OA EG TL ES; Phasage 4 D




**Projet EuroAirport**

Multi - Projets / Multi - Métiers

Phasage 4 D; Interfaces Projets: Extension Aérogare / Prolongement Tram; A35 / ZAC / Centre Commercial / Piste Cyclable

**Agrandissement BV Issy les Moulineaux**

Métier EG (rehaussement quais + réseaux d'assainissement

Coord. BIM AREP

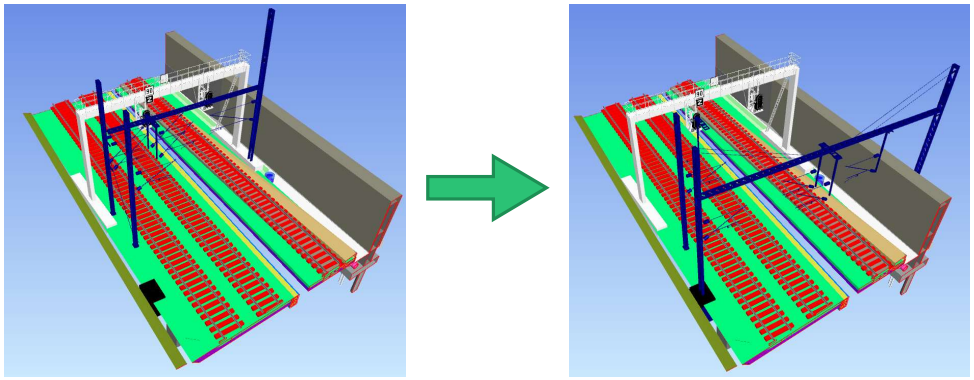
**Interconnexion en Gare de Bondy**

Métiers OA EG TL ES EE; Phasage 4 D

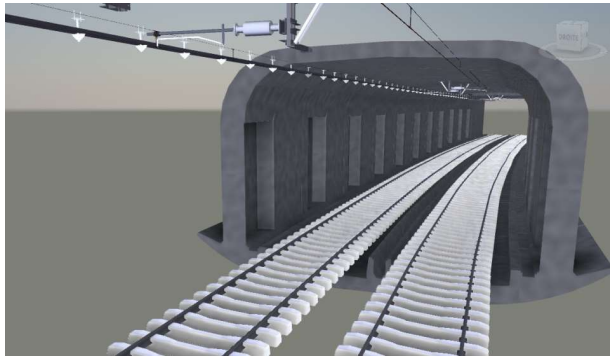
# BIM DEPLOYEMENT AT SNCF R

## INDUSTRIALIZATION OF BIM ON RAILWAYS DESIGN PROJECTS

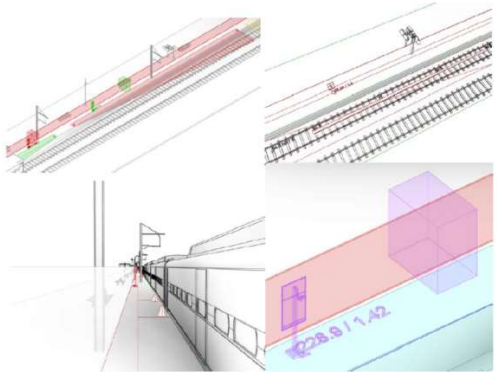
Coordination
SIG/CAT



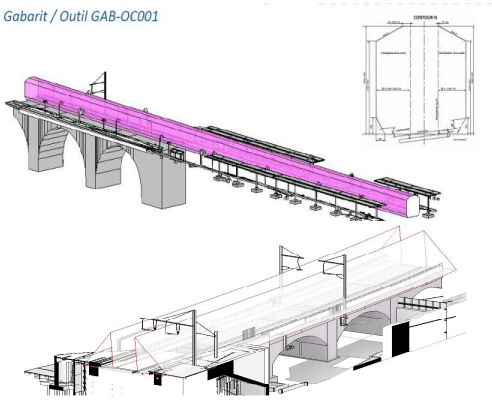
Coordination Track / Assets



Tunnels



Telecom




Requirements management

SNCF RÉSEAU

AUTODESK UNIVERSITY

# BIM DEPLOYEMENT AT SNCF R

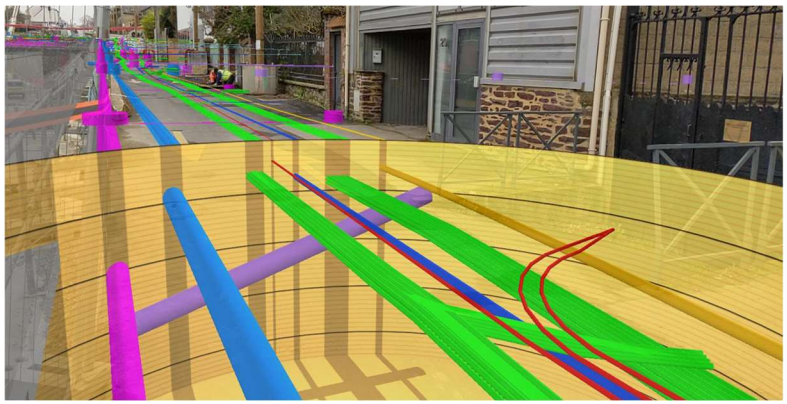
## INDUSTRIALIZATION OF BIM ON RAILWAYS CONSTRUCTION PROJECTS

**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**



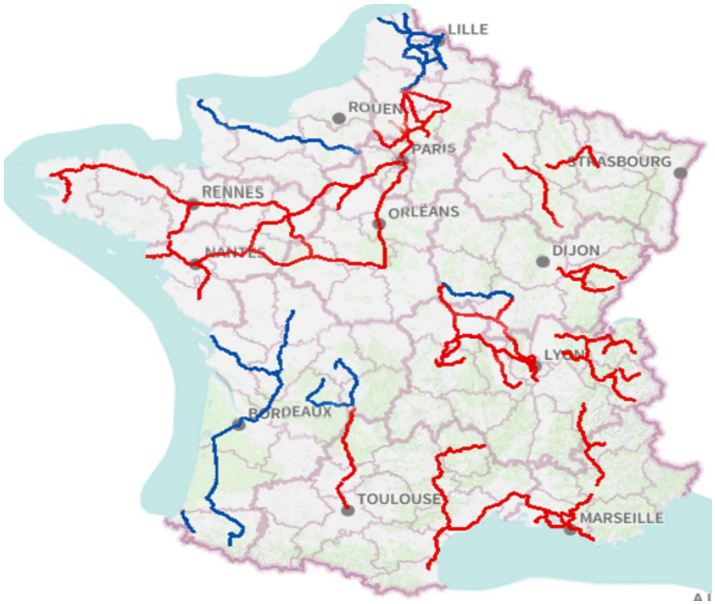



SNCF RÉSEAU

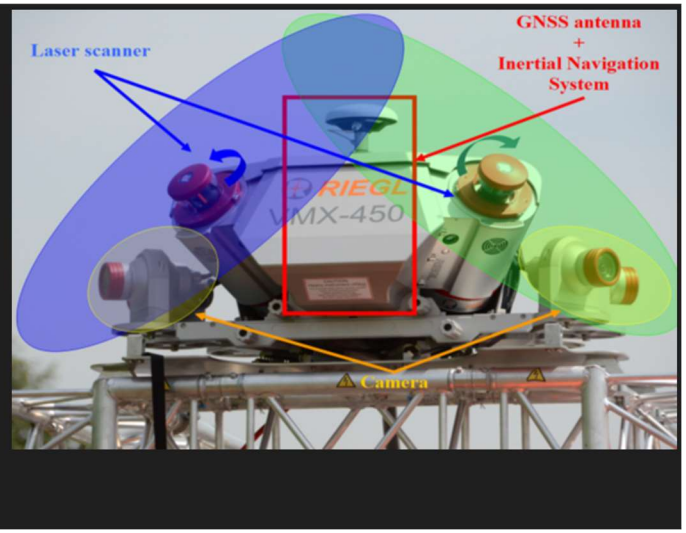
AUTODESK UNIVERSITY

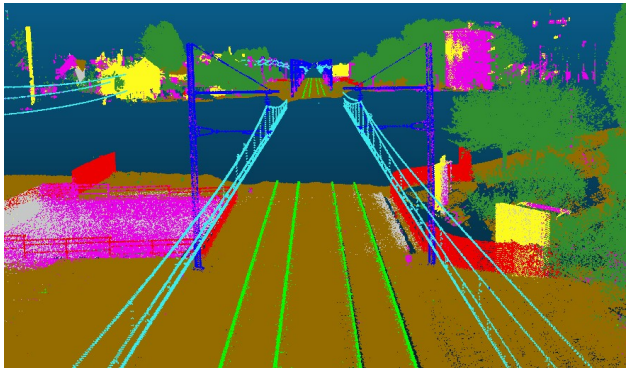
# BIM DEPLOYEMENT AT SNCF R

## INDUSTRIALIZATION OF BIM ON RAILWAYS PROJECTS : LASER SCANING




Laser scanning



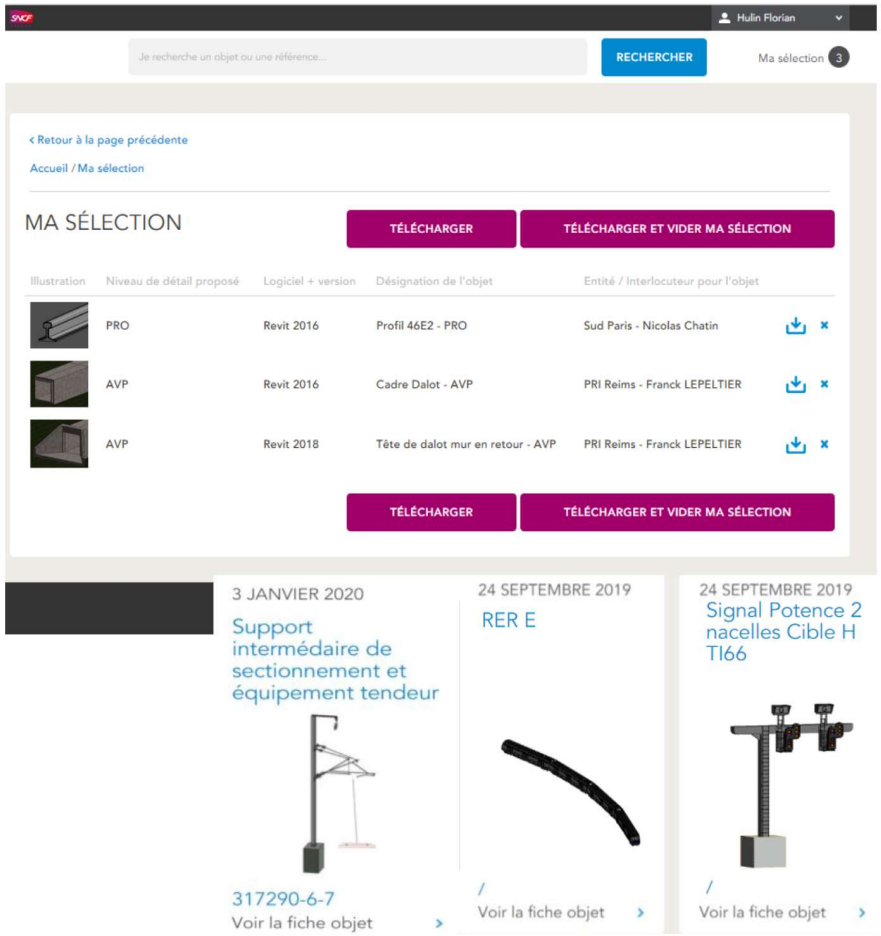



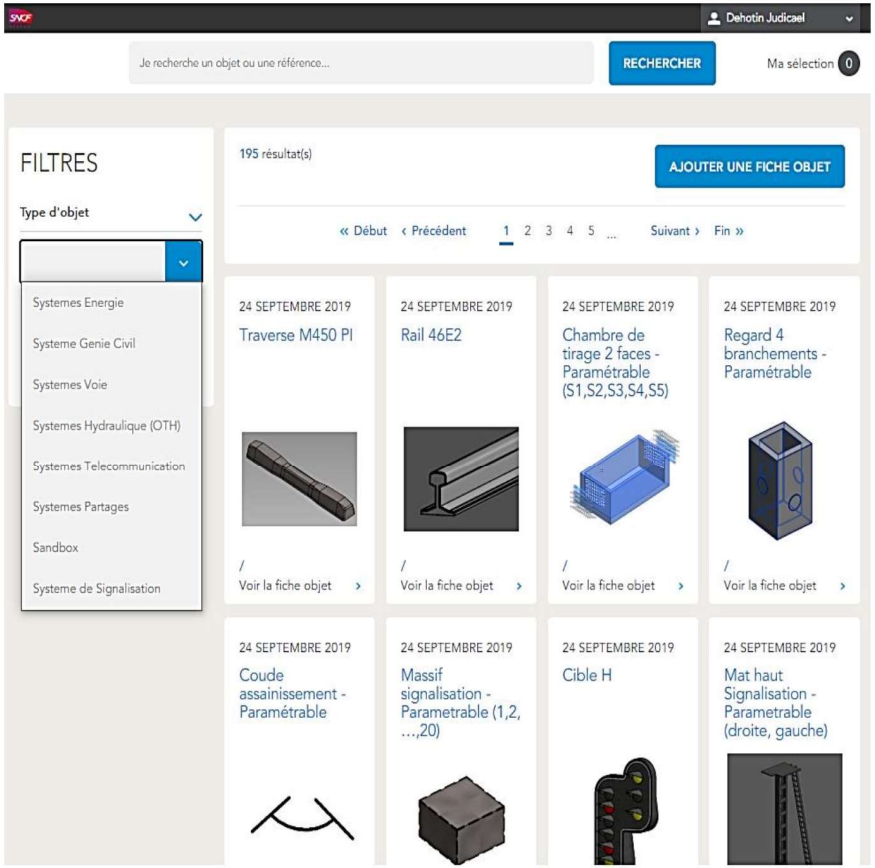
SNCF RÉSEAU

AUTODESK UNIVERSITY

# BIM DEPLOYEMENT AT SNCF R

## INDUSTRIALIZATION OF BIM ON RAILWAYS PROJECTS : OBJECT LIBRARY




SNCF RÉSEAU

AUTODESK UNIVERSITY

# 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

SNCF RÉSEAU

AUTODESK UNIVERSITY

# BIM AT SNCF RESEAU

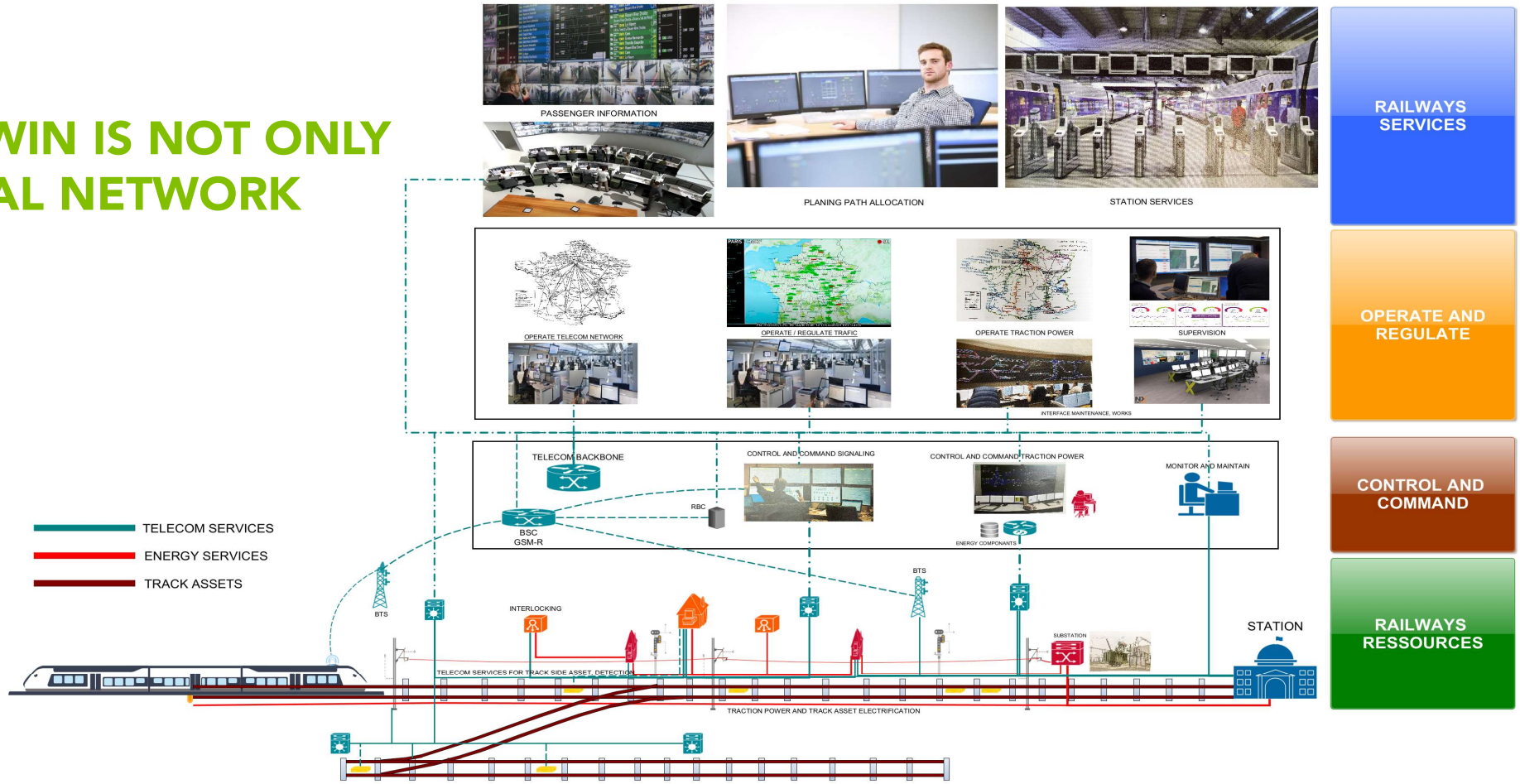
## BIM DESIGN CONTSRUCTION TO DIGITAL TWIN

SNCF RÉSEAU

# BIM DEPLOYEMENT AT SNCF R

## DIGITAL TWIN DYNAMICS

**DIGITAL TWIN IS NOT ONLY THE DIGITAL NETWORK REPLICA**

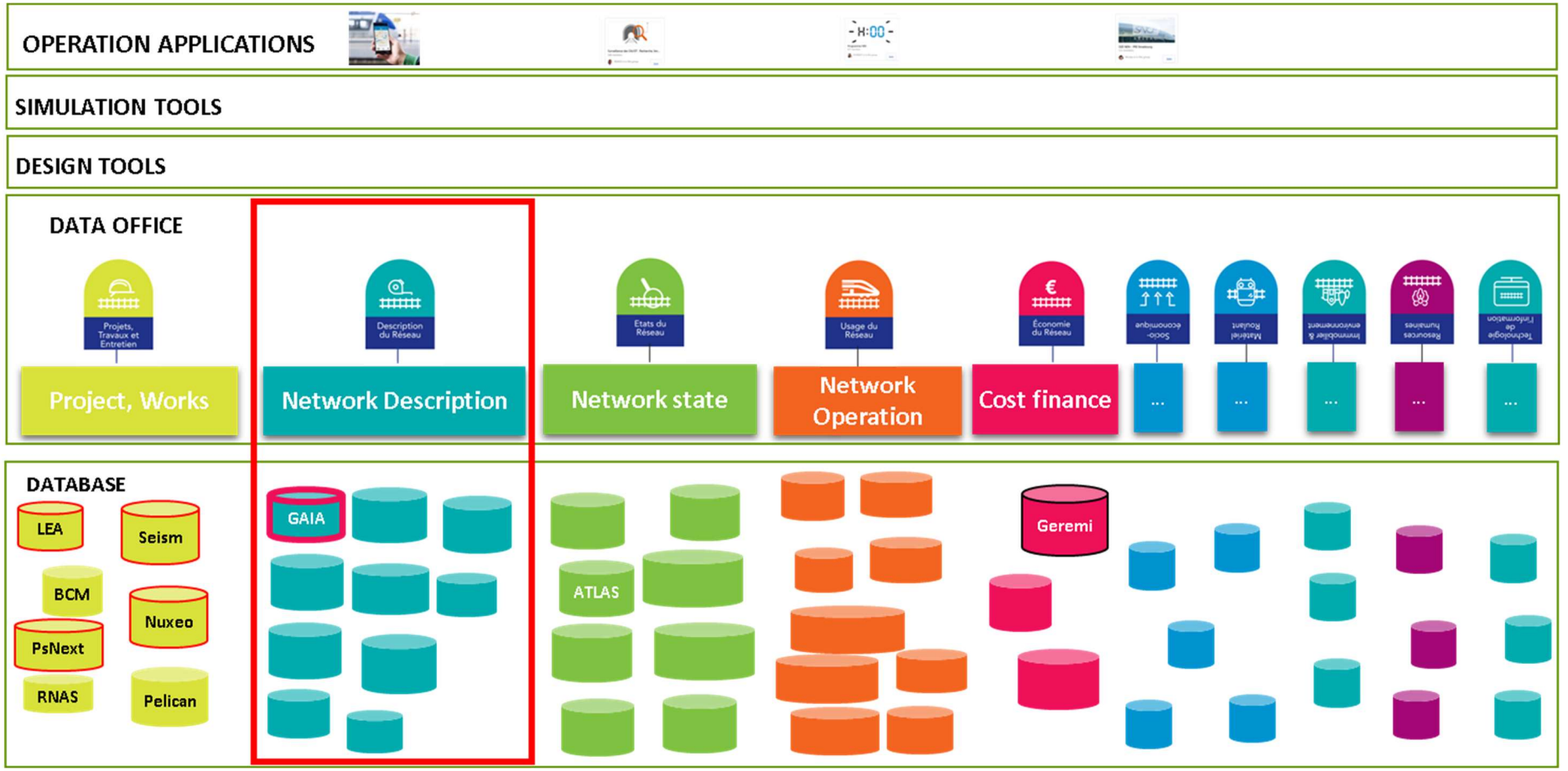



SNCF RÉSEAU

AUTODESK UNIVERSITY

# BIM DEPLOYEMENT AT SNCF R

## DIGITAL TWIN DYNAMICS : IT LEGACY DATABASES BIG PICTURE




SNCF RÉSEAU

AUTODESK UNIVERSITY

# BIM DEPLOYEMENT AT SNCF R

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

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

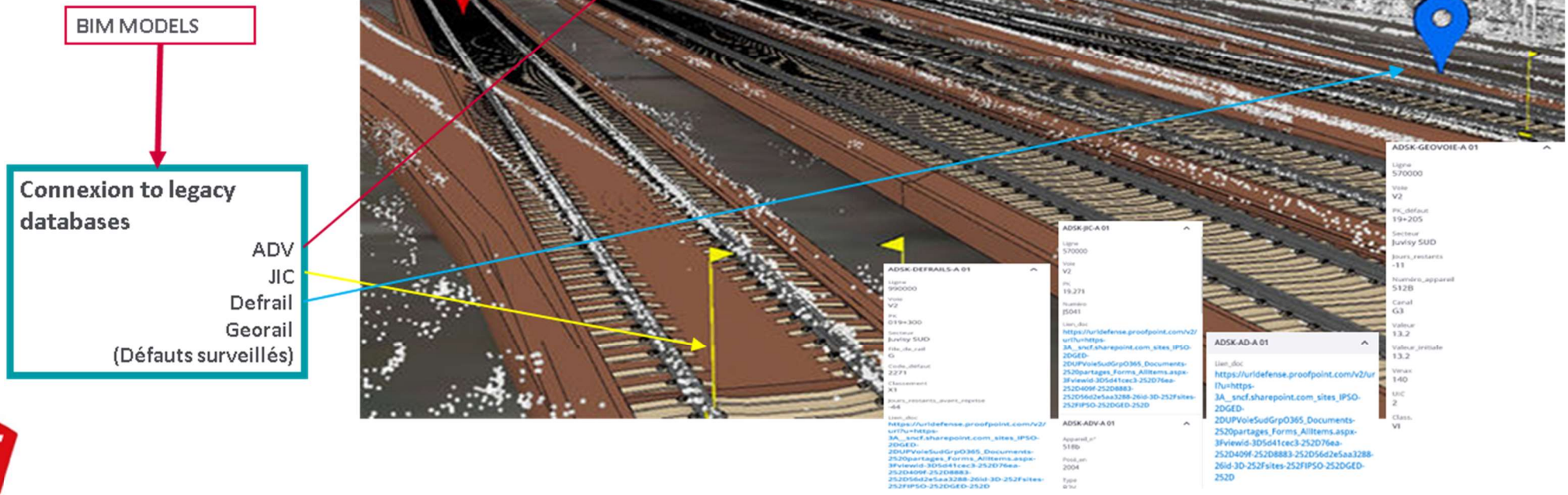
« **The will to mobilise the rail industry on a digital deployment, throughout the continuous and sustainable life cycle of the infrastructure** »


*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 USE CASE DEVELOPEMENT

EXPERIMENT BIM ON
TRACK MAINTENANCE ON
JUVISY SECTOR

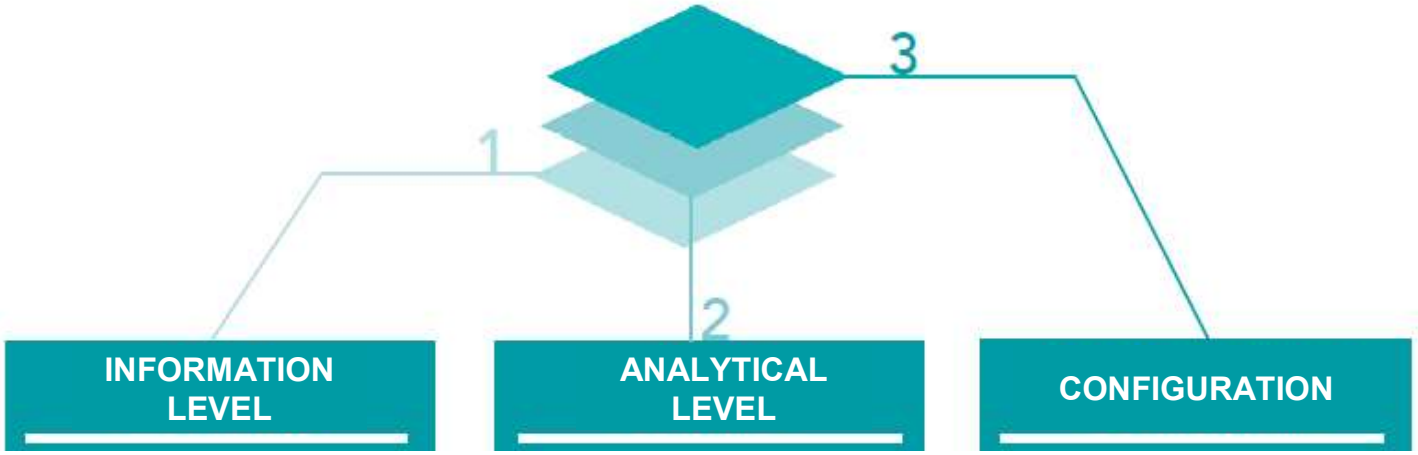



SNCF RÉSEAU

AUTODESK UNIVERSITY

# BIM DEPLOYEMENT AT SNCF R

## DIGITAL TWIN




SNCF RÉSEAU

AUTODESK UNIVERSITY

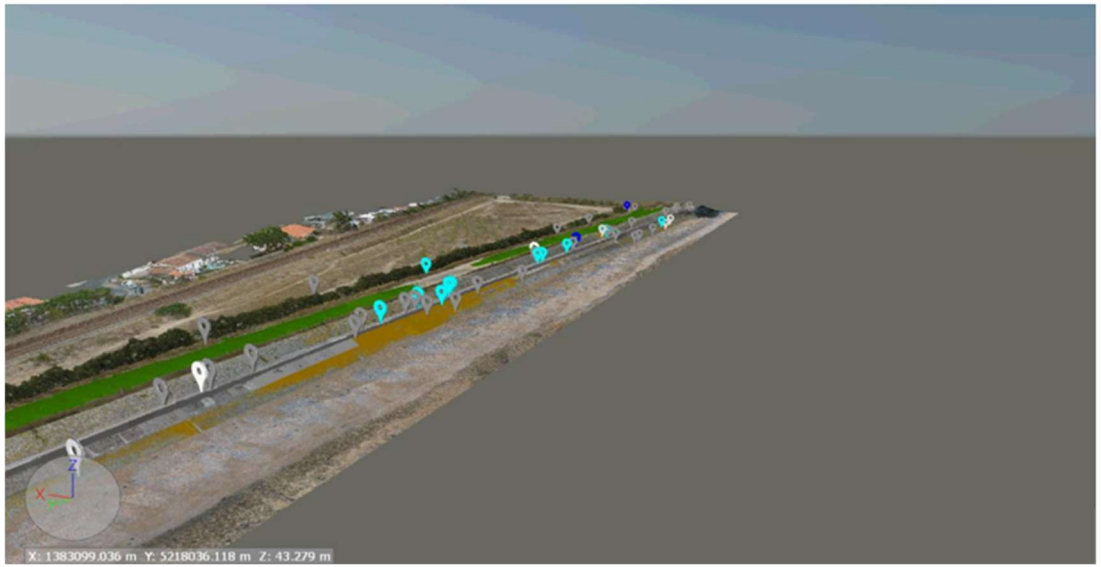
# BIM DEPLOYEMENT AT SNCF R

## DIGITAL TWIN DIGITAL TWIN USE CASE DEVELOPEMENT

USE case # 2
BIMDigue

À partir d'une
multitude de sources

INSPECTION OF WORKS



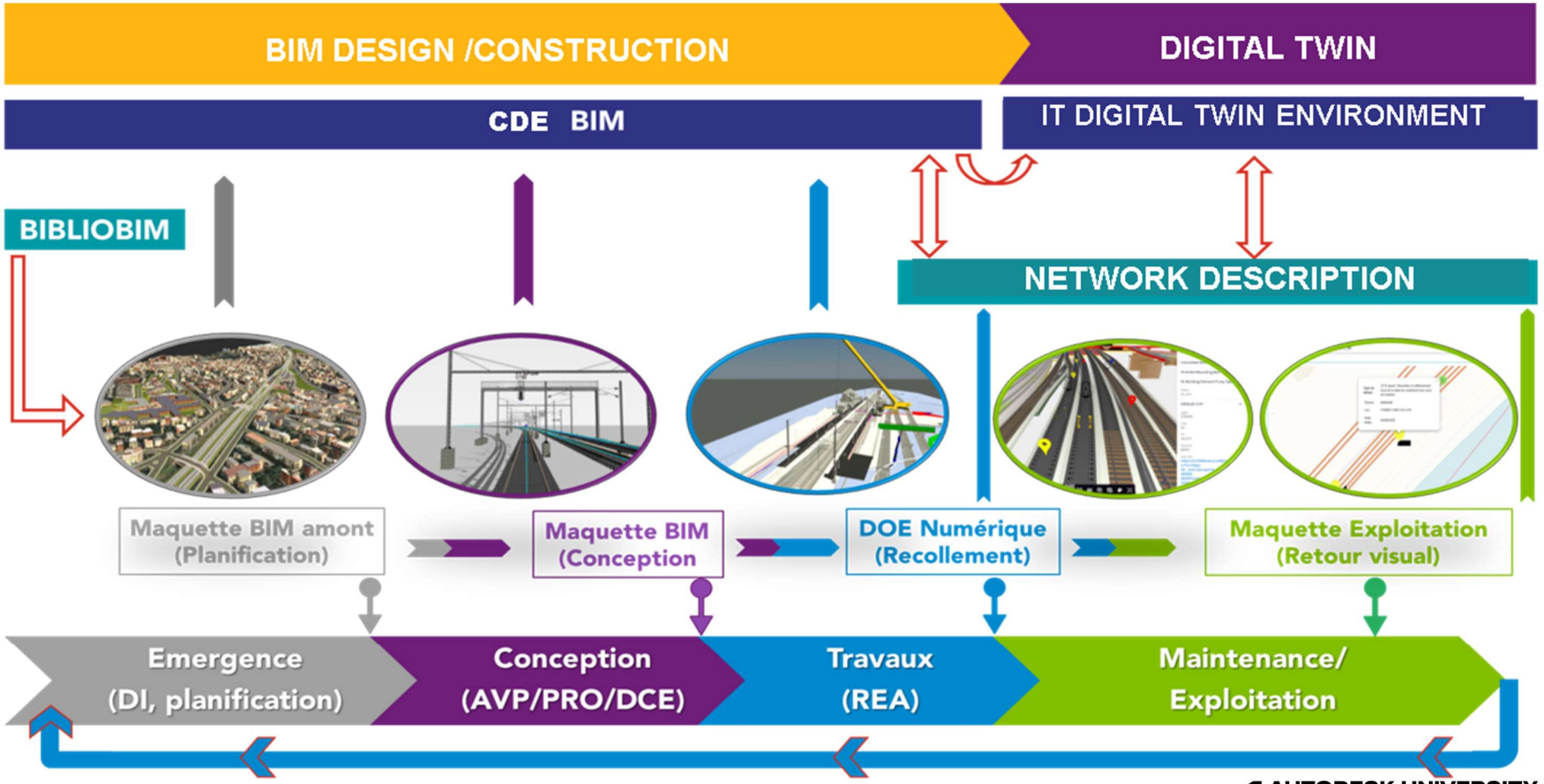


SNCF RÉSEAU

AUTODESK UNIVERSITY

# BIM DEPLOYEMENT AT SNCF R

## DIGITAL TWIN AND BIM : DIGITAL CONTINUITY

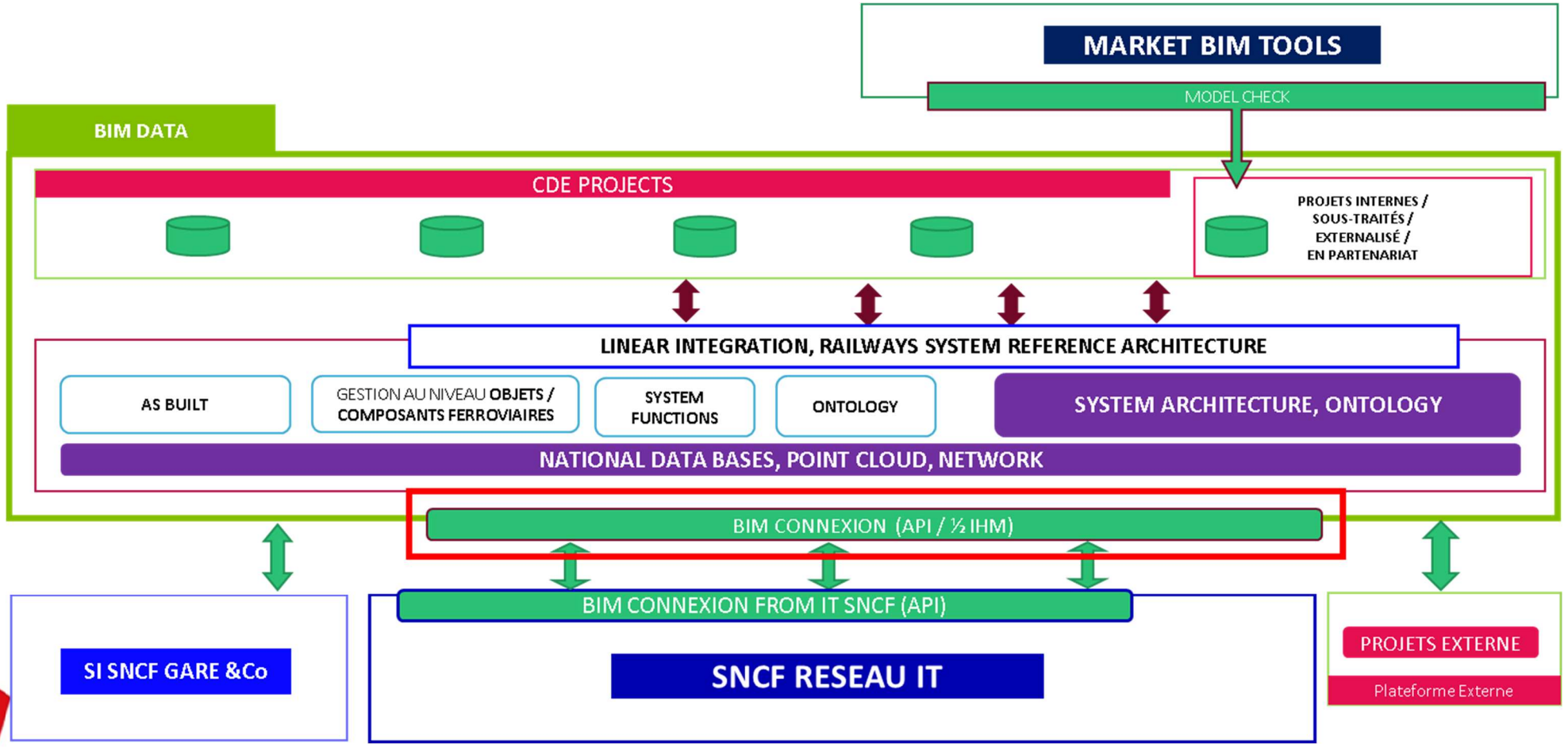



SNCF RÉSEAU

AUTODESK UNIVERSITY

# BIM DEPLOYEMENT AT SNCF R

## DIGITAL TWIN  AND BIM CONTINUITY : BIM AND IT CONNEXION

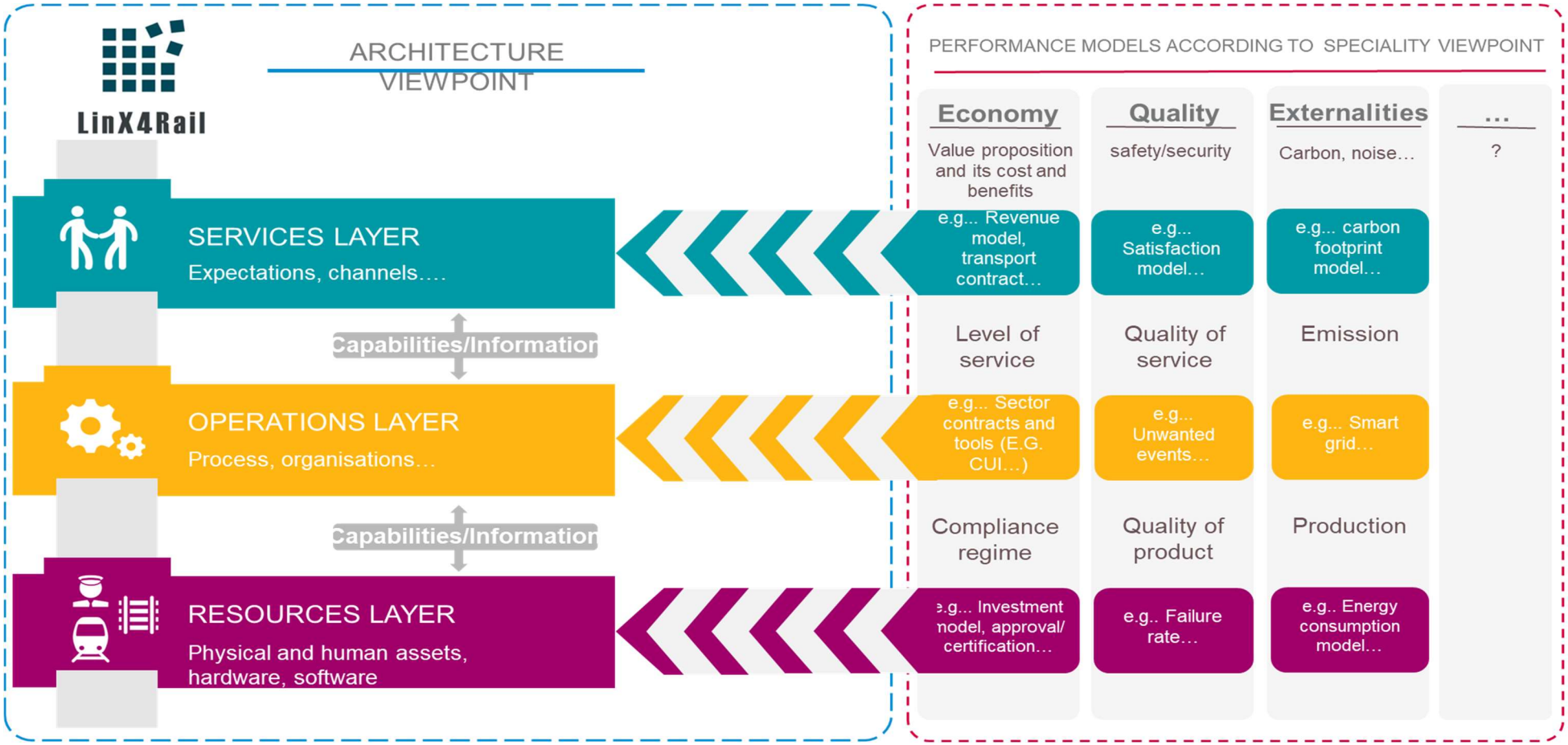



SNCF RÉSEAU

AUTODESK UNIVERSITY

# BIM DEPLOYEMENT AT SNCF R

## DIGITAL TWIN DYNAMICS

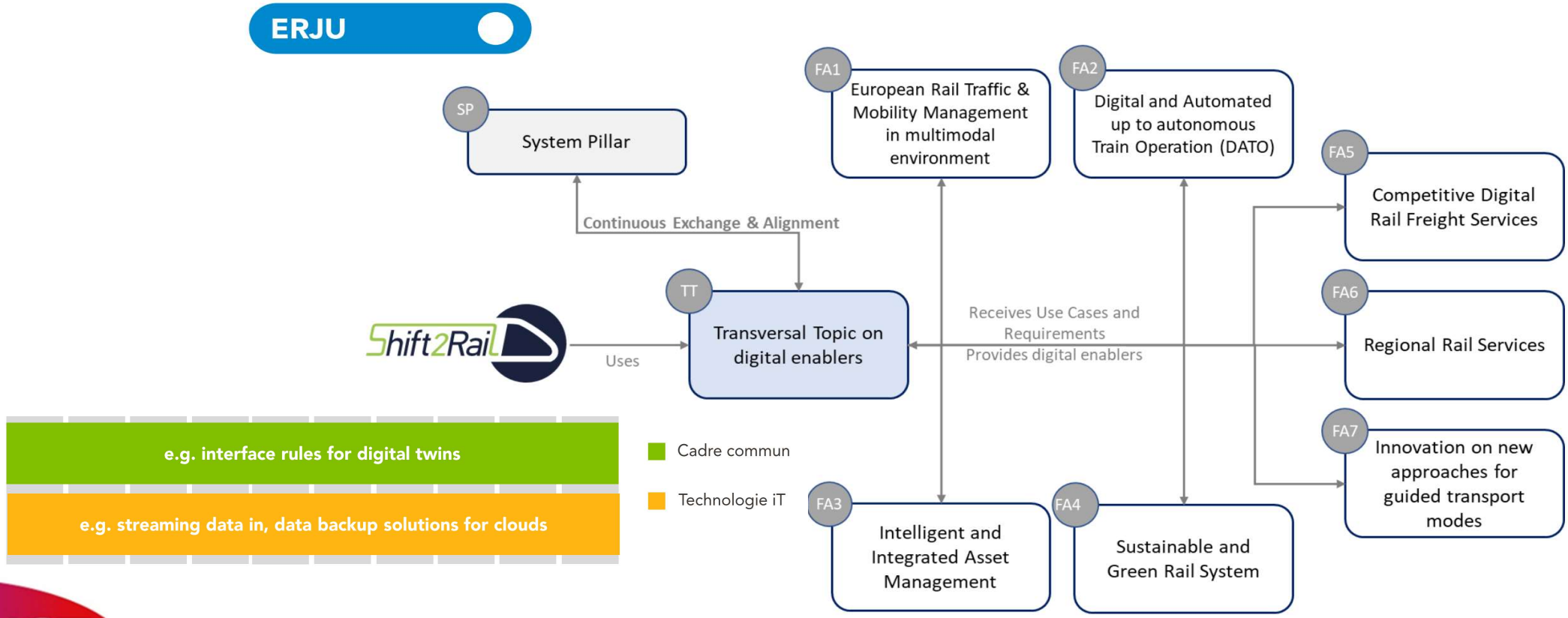



SNCF RÉSEAU

AUTODESK UNIVERSITY

# BIM DEPLOYEMENT AT SNCF R

## DIGITAL TWIN : SYSTEM PILAR (EU RAIL)




SNCF RÉSEAU

AUTODESK UNIVERSITY

AUTODESK UNIVERSITY

# BIM AT SNCF RESEAU

## BIM REQUIREMENT STRUCTURE AND IMPACT ON TOOLING BIM

SNCF RÉSEAU

# SNCF RESEAU BIM REQUIREMENT

## BIM PRODUCTION REQUIREMENT – RELEASE 2022 (NEEDS)

### BIM VALUE FOR RAILWAYS PERFORMANCE

Defining BIM Objectives and Uses cases, focused on SNCF Reseau Stakes

### 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

### 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

SNCF RÉSEAU

AUTODESK UNIVERSITY

# SNCF RESEAU BIM REQUIREMENT

## BIM PRODUCTION REQUIREMENT – RELEASE 2022 (What we observe)

### BIM VALUE FOR RAILWAYS PERFORMANCE

**Too generic BIM Uses** 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**

### BIM MANAGEMENT IN RAILWAYS PROJECTS

**BIM process are looks by Railways specialist like as foreign** to their process and working methods.

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

### DESIGN AND CONSTRUCTION PHASES

BIM Design **tool are not specific to railways sub-domain** and railways experts spent many time to adapts existing tools to create models that’s are not really fit to the suitable design process.

We **need specific tools for railways design**, not adaptation of existing tools who initially have other objectives. We need more engineering and Rail data in BIM Model

### TOOLS AND DATA STRUCTURE

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

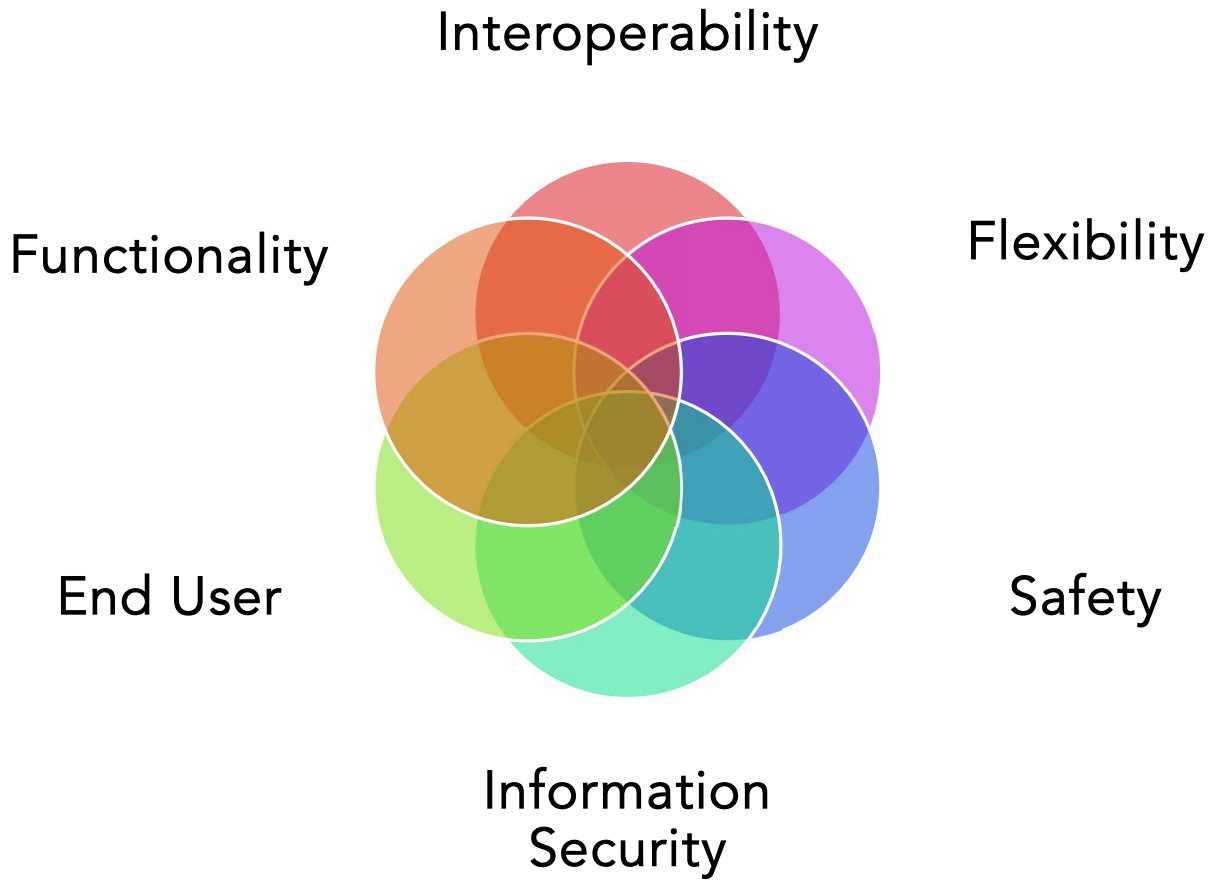
SNCF RÉSEAU

# 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**

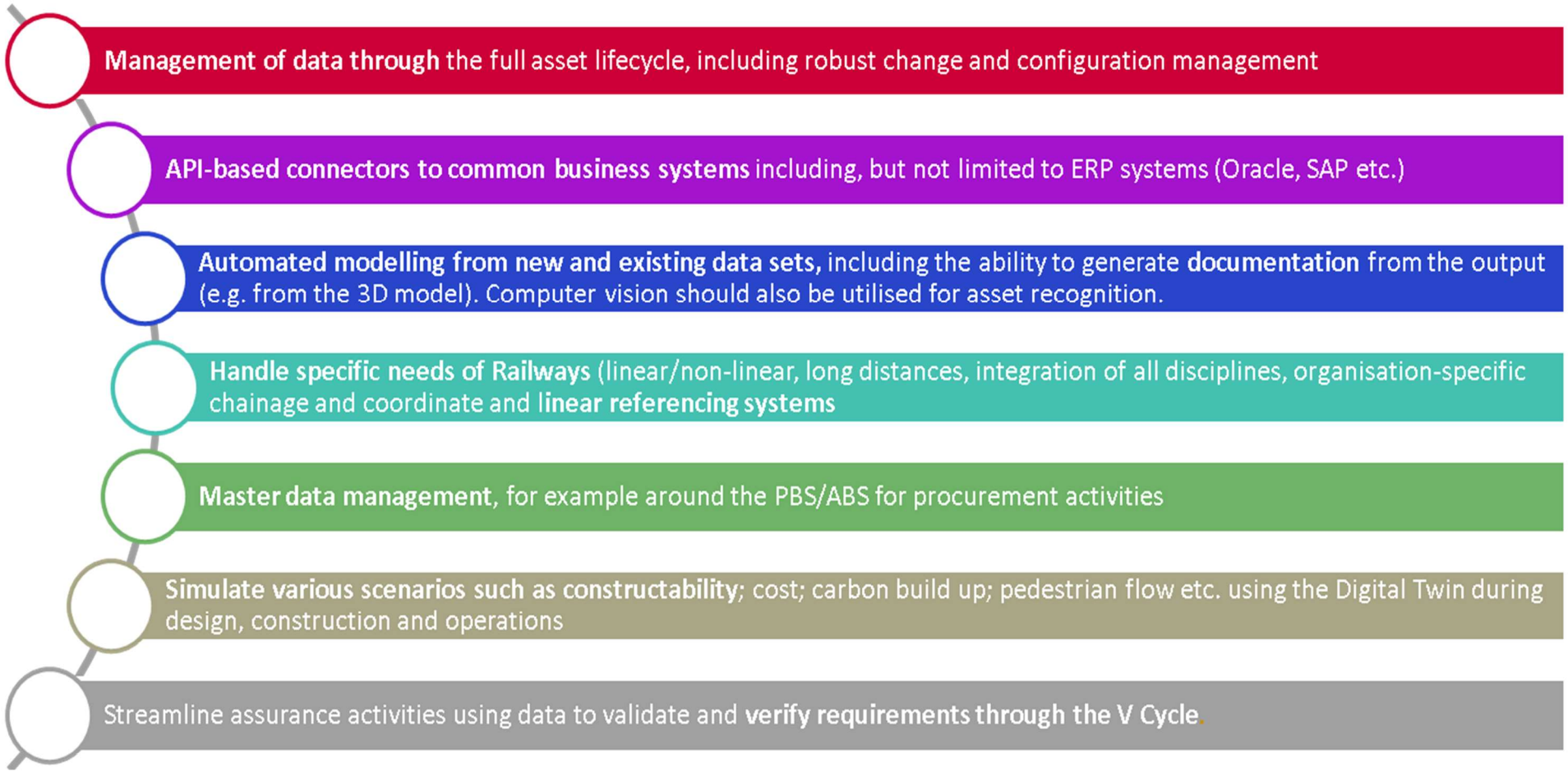



SNCF RÉSEAU

AUTODESK UNIVERSITY

# SNCF RESEAU BIM REQUIREMENT

## RAILWAYS BIM USER'S GROUP




SNCF RÉSEAU


# AUTODESK UNIVERSITY