Europe's Rail

FP1 MOTIONAL

European Rail Network and Mobility Management

Mid-Term Event

Madrid & Online 29.10.2024

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Lars Deiterding

Hacon Ingenieurgesellschaft mbH

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David Iban Villalmanzo Resusta

Administrador de Infraestructuras Ferroviarias

Towards a reliable integrated European railway network

Europe's Rail

Codruta Bastucescu

Programme Manager

Europe's Rail

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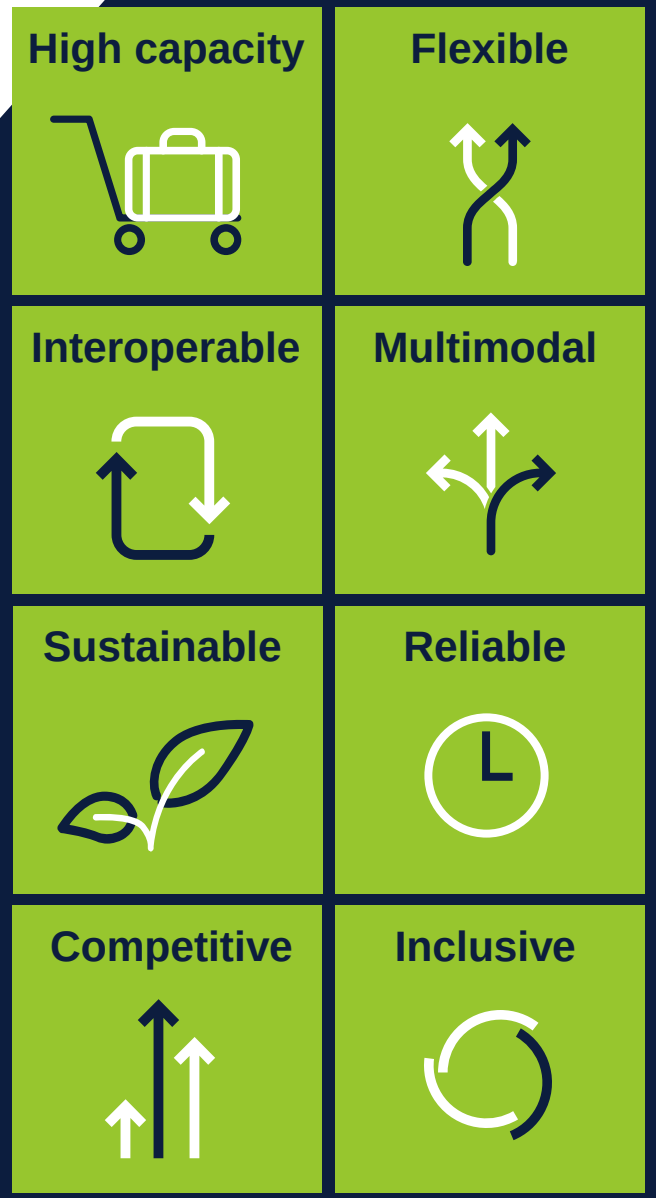
Vision

To deliver a **fully integrated European railway network for citizens and cargo.**



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Objectives

General

Single European Railway Area

Transition to integrate European rail system into the wider mobility system

Strong European rail industry

Specific

- Integrated European railway network
- Sustainable and resilient rail system
- Unified operational concept and a functional, safe, and secure system architecture
- Competitive green rail freight
- Demonstration projects
- Strong and globally competitive European rail industry
- Synergies with other EU policies, programmes, initiatives, instruments, or funds

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Towards a green and digital Europe

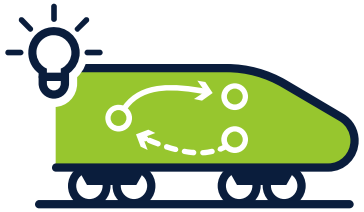
EUROPEAN GREEN DEAL
climate neutrality by 2050

DIGITAL DECADE
bringing Europe to the forefront of digitalisation and automation

SUSTAINABLE AND SMART MOBILITY STRATEGY
articulating the pathways towards digitalisation and greening the transport sector

INDUSTRIAL STRATEGY
enhancing Europe's rail supply industry competitiveness

EU-Rail will play an instrumental role
in the achievement of the specific milestones
for rail research and innovation



Building on S2R achievements

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Forward-looking activities

Disruptive technologies and thinking
(SMEs, start-ups, and research community)

Exploratory research

DELIVER
Sustainable and Smart Mobility Strategy rail OBJECTIVES

AI GENERATED

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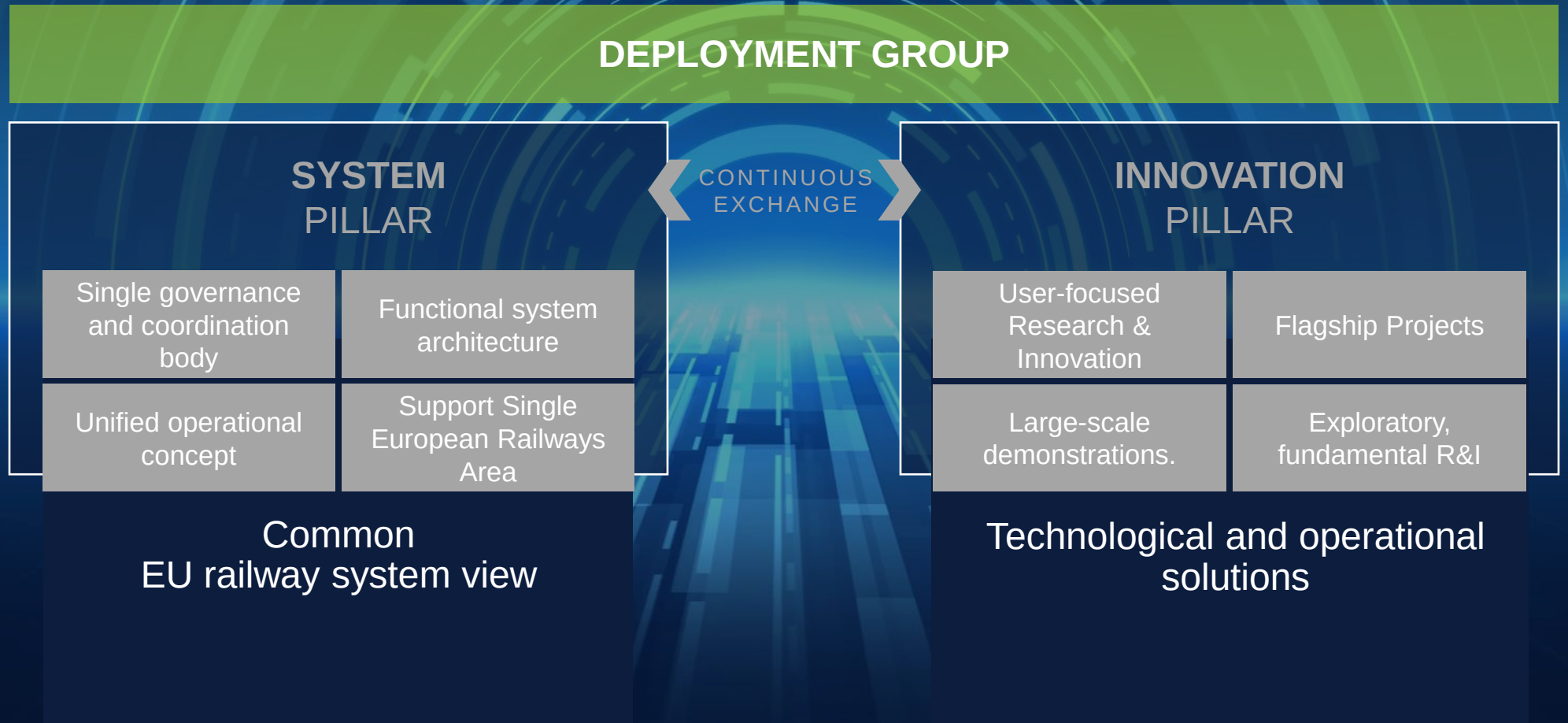
Single R&I Programme based on a system view



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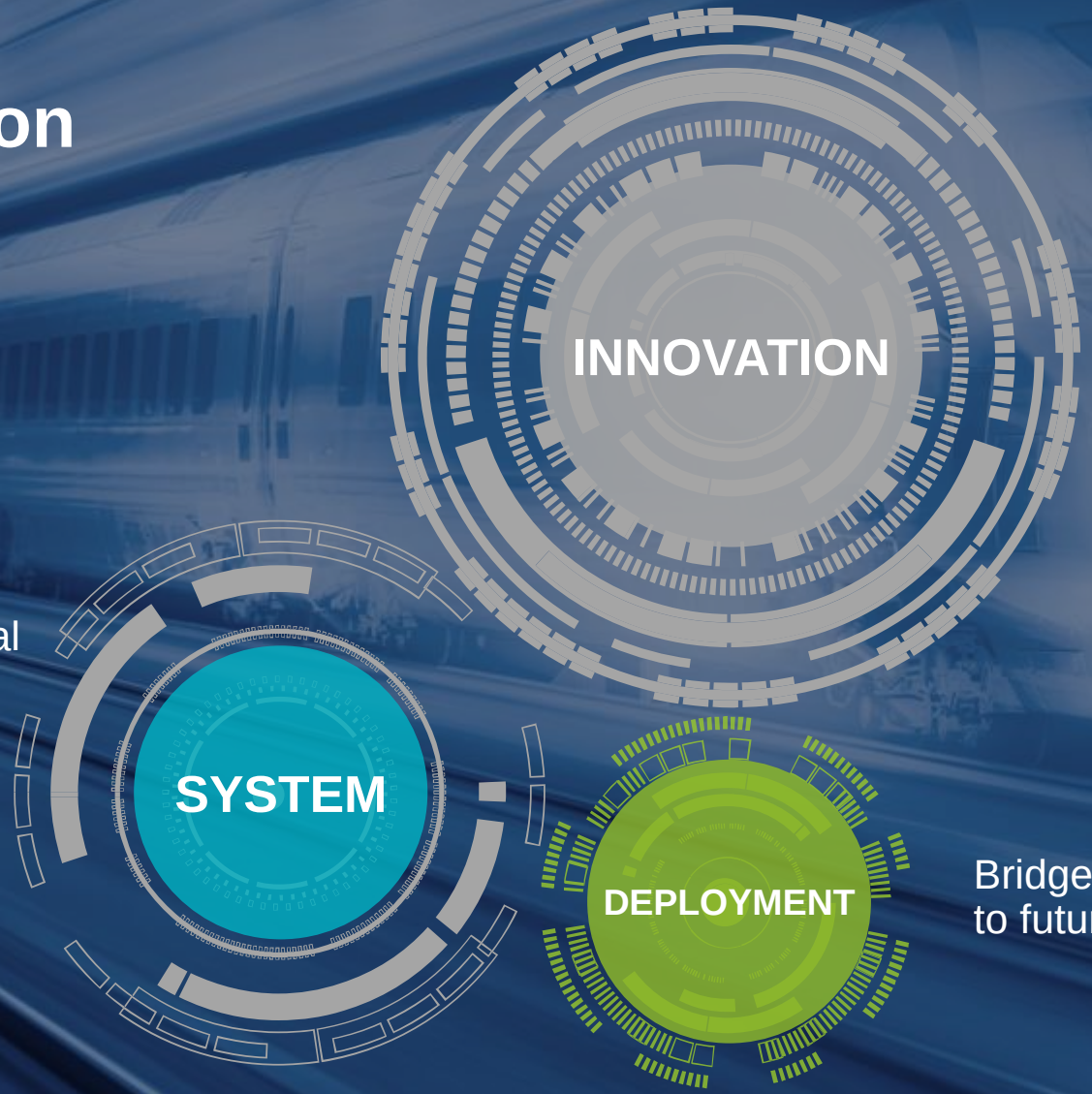
Implementation



- Ensure that the functional system architecture
- Flexibility in implementation
- Ownership of results

Members contribution up to
€576 million

Call 2022 (50% of R&I)
Call 2025/2026 (30%)
Call 2027: activities until 2031

Launching calls for proposal/tenders to explore new areas of rail R&I

Bridge research and innovation to future coordinated deployment

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Deployment Group
from innovation to market

- **Diversity** of situations across the EU
- European **coordination** of deployment
- **Technical/operational** migrations plans
- Investment plan, funding, and **financing**

TODAY'S FOCUS:

- Future Railway Mobile Communication System - **FRMCS** / future radio
- **DAC**
  a comprehensive migration strategy to coordinate deployment, in accordance with COM(2023)441 on Greening Rail Freight Transport

Flagship Areas (FAs) / Projects (FPs)

- **FA1**: **European Rail Traffic Management System (TMS)/ Capacity Management System (CMS); multi-modal** D2D Mobility integration: **FP1-MOTIONAL & TRAVEL WISE FP**
- **FA2:** Digital and automated up to **autonomous train operations: FP2 – R2DATO**
- **FA3:** Intelligent and integrated **asset management: FP3-IAM-4RAIL**
- **FA4:** Sustainable and green rail system: FP4-Rail4Earth
- **FA5:** Sustainable **competitive digital green rail freight** services: FP5-TRANS4M-R
- **FA6:** Regional rail services / innovative rail services to **revitalise capillary lines: FP6-FutuRe**
- **FA7:** Innovation for new approaches on **guided transport modes: Pods4Rail**

Exploratory research activities

- Technologies and innovations from other sectors
- Game changing methodologies
- Disruption of innovation cycle

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1 Dec 2022 – 30 September 2026

GOALS

European level:

- Improved planning for rail services
- Improved management of rail operations
- B2B / D2D Multi-modal integration of rail services

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FP1-MOTIONAL: TRANSVERSAL TOPICS (TT)

DIGITAL ENABLERS

- Conceptual Data Model (CDM) & semantic dictionary evolution
- Federated Rail Data Space
- Digital Asset Engineering
- Digital Twin
- Repository for digital models, processes and relevant use cases across all FPs and SP

TRAVEL WISE

First rail-aviation synergy flagship project

1 October 2024 – 30 September 2027

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GOALS

- Support the shift from rail and air traffic orchestration in silos to an intermodal approach
- Create an Intermodal Collaborative Decision Making to support Air-Rail operations management for nominal situations and disruptions
- Optimisation of passenger experience

Thank you

White Atrium Building, 2nd Floor
Avenue de la Toison d'Or 56-60
B1060, Brussels - Belgium

www.rail-research.europa.eu

Flagship Area 1:

Network management planning and control & Mobility Management in a multimodal environment

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Key Note: Workstream 2 Digital Enablers

Digital Challenge

#1: Disruptions

- Disruptions in Rail Operations
- Disconnected from other transport modes
- Supply Chain disruptions

Digital Challenge

#2: Fragmentation of data

- Silos within and in companies
- Data storage and analysis based on individual use cases

Digital Challenge

#3: Reluctance to share

- Security concerns
- Liability concerns
- Competitive concerns

Digital Challenge

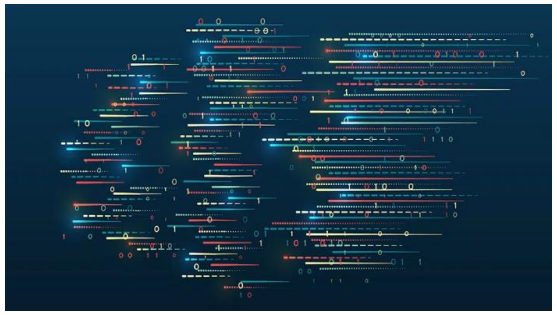
#4: Lack of interoperability

- Between data types
- Between standards
- Between data storages

Digital challenges in the Rail industry

Disruptions

- Disruptions in Rail operations
- Disconnected from other transport modes
- Supply Chain disruptions



Fragmentation of data

- Silos within and in companies
- Data storage and analysis based on individual use cases

Reluctance to share

- Security concerns
- Liability concerns
- Competitive concerns

Lack of interoperability

- Between data types
- Between standards
- Between data storages

Challenges result in underutilization of innovation potential
New approach needed!

Flagship Area 1:

Network management planning and control & Mobility Management in a multimodal environment

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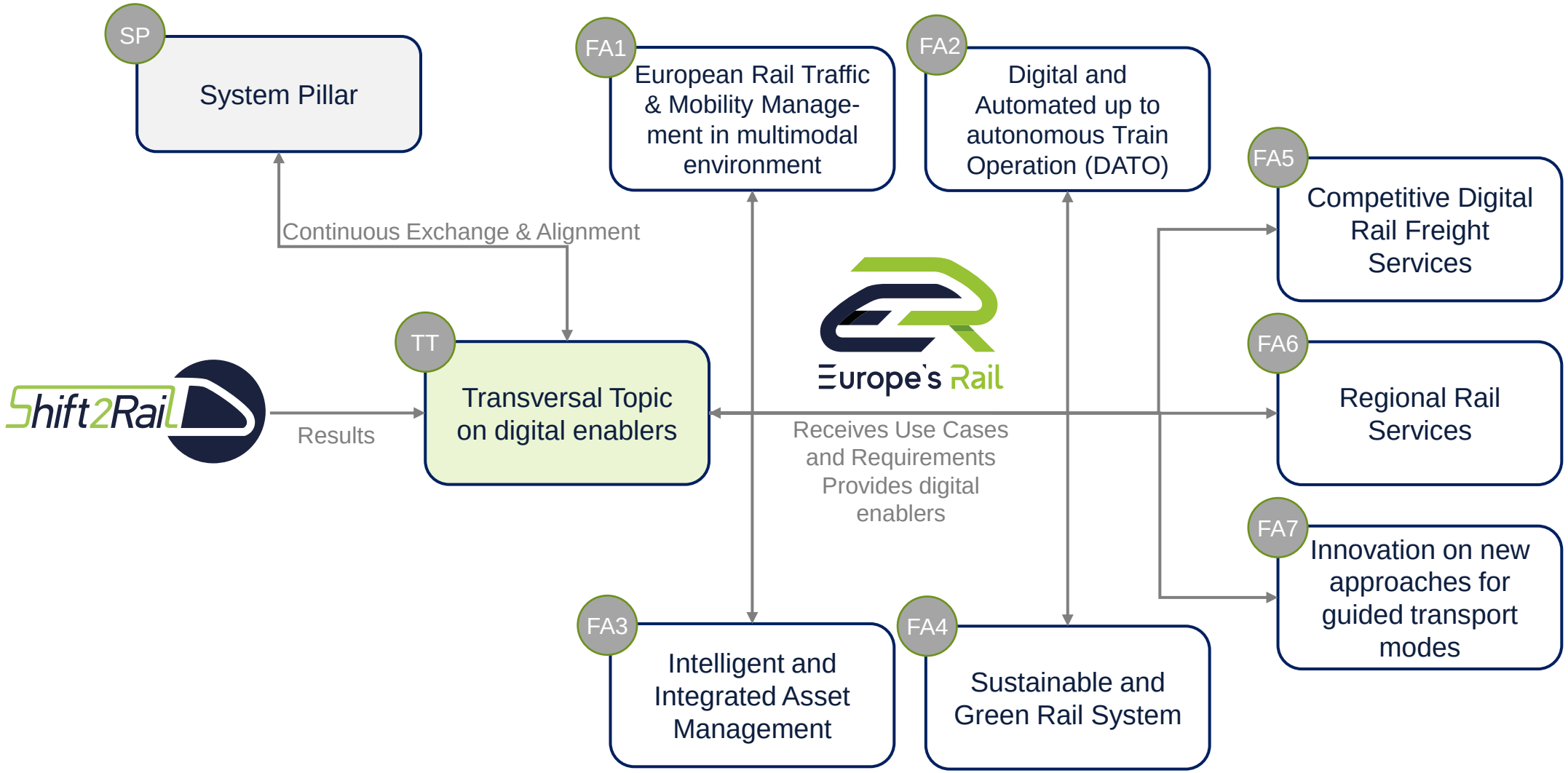
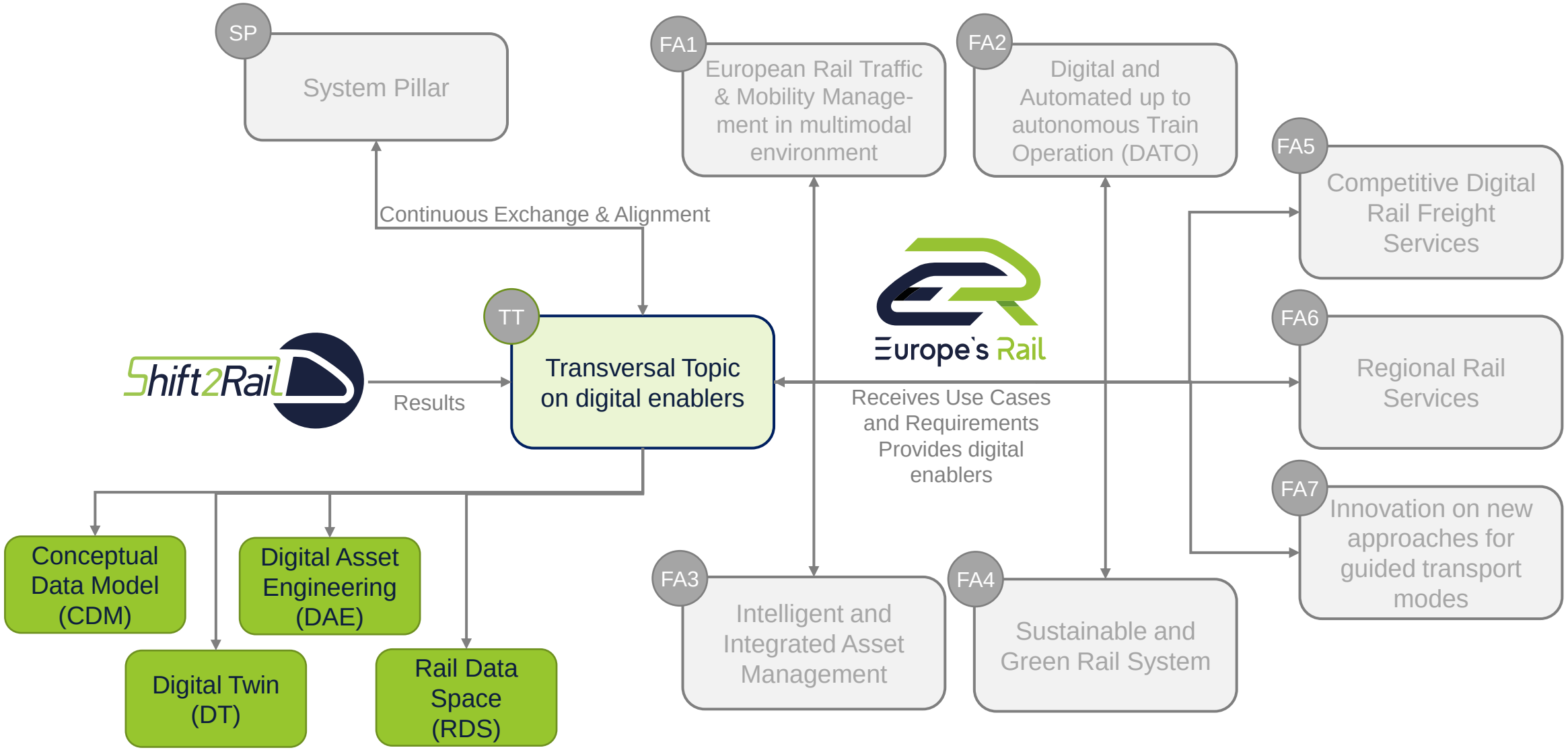
Key Note: Workstream 2 Digital Enablers

Digital Enablers Landscape in the Europe‘s Rail Joint Undertaking

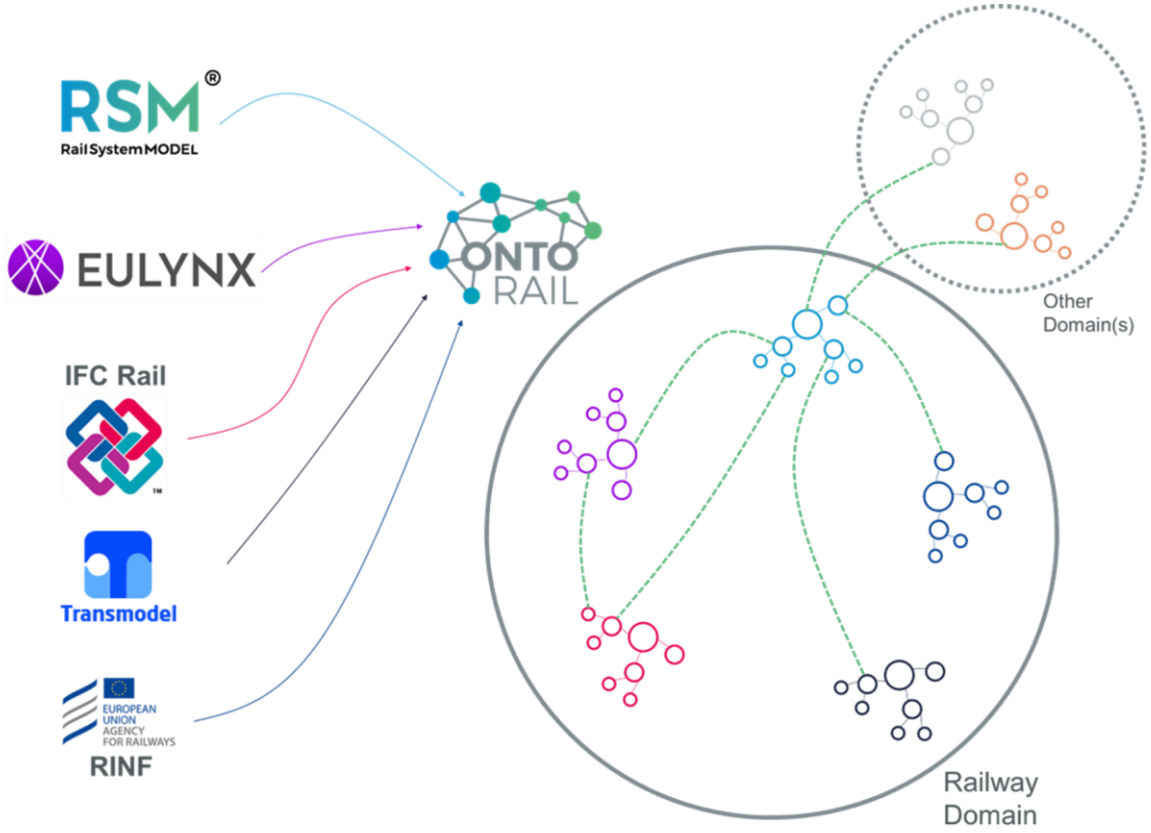


Digital Enablers Landscape in the Europe‘s Rail Joint Undertaking



Conceptual Data Model (CDM)

OBJECTIVE: The Conceptual Data Model aims at creating a common standardised ontology based machine-readable model of the rail system domain, formally describing syntactic and semantic data structures.



Benefits

- Enables interoperability among source models
- Source of Knowledge for domain users
- Fosters reuse and maintainability of the information systems

Digital Asset Engineering (DAE)

OBJECTIVE: The Goal of DAE is to fully digitalize the Engineering process of railway assets (CCS, Stations, etc.) to ease engineering work, reduce costs of development and testing, and reduce time to deployment.

Challenges

- Paper-based design processes are prone to information loss
- Incomplete information delays the corrective maintenance process
- High cost of information exchange(non standardized formats)

Benefits

- Increases economic benefits by reducing entrance barrers to new markets
- Increased operation efficiency(predictive maintenance/Monitoring through DT)
- Optimize rail operation and reduce energy consumption and emissions
- Automation saves time in design and construction phases.

Digital Twin (DT)

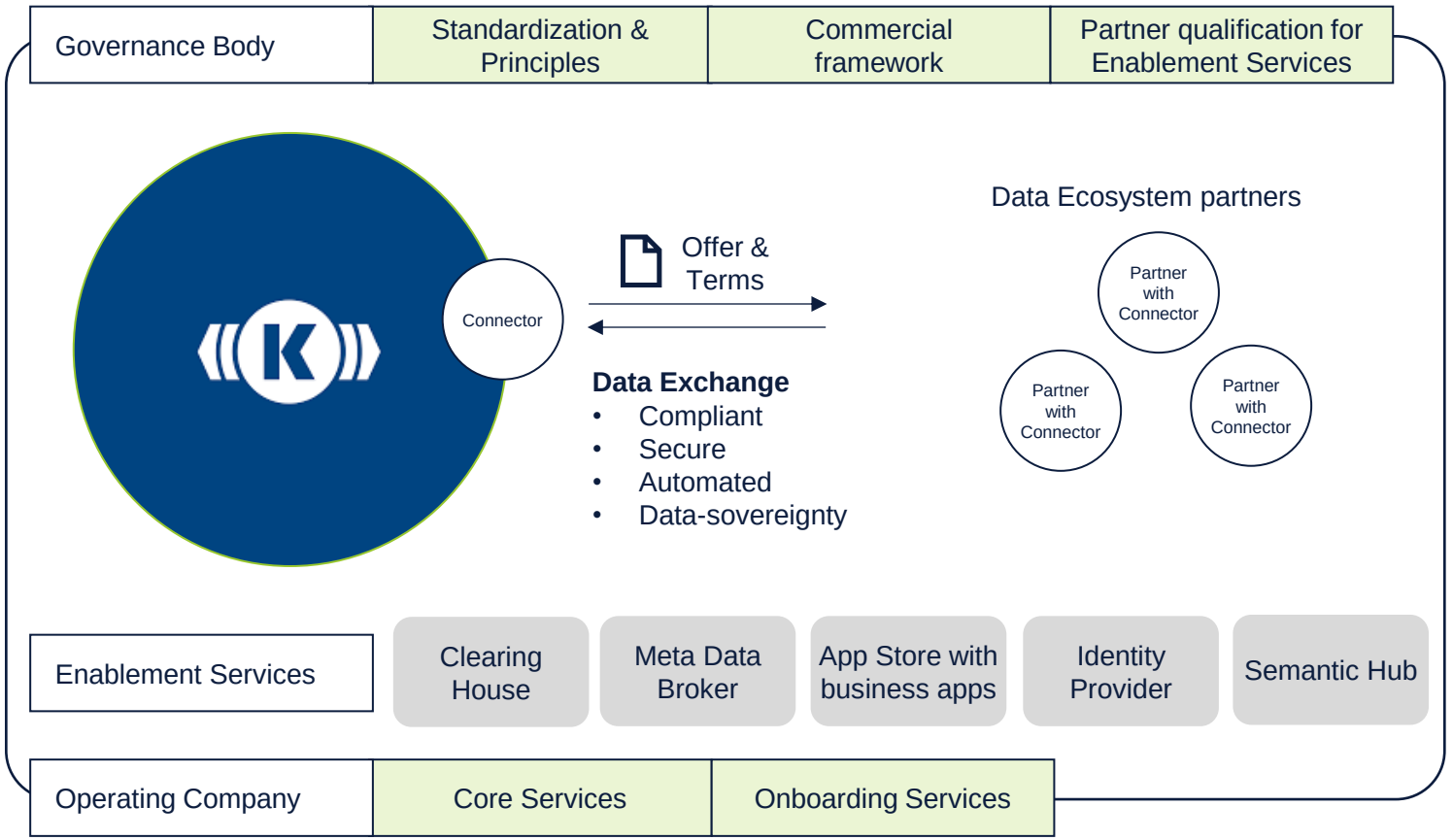
OBJECTIVE: The DT enabler aims to organise and support the assembly, verification, validation, testing and co-simulation of complex high-order Digital Twins. Modularity, interoperability and composability of the digital representation of the physical railway system are particularly in focus.

Benefits

- Increases Assets utilization and Sustainability
- Enables exchange of digital artefacts of railway assets
- Reduces operational cost through predictive maintenance
- New opportunities with AI

Decentralized, open and secure Rail Data Space (RDS) to drive Rail Innovations

Rail Data Space



Benefits

Compliant with EU legislation including EU Data Act

Maintain data ownership by defining who can access data and under what terms

Full transparency and verification of data transactions

Most efficient way to share data with multiple parties

Shared costs of scalable data space infrastructure

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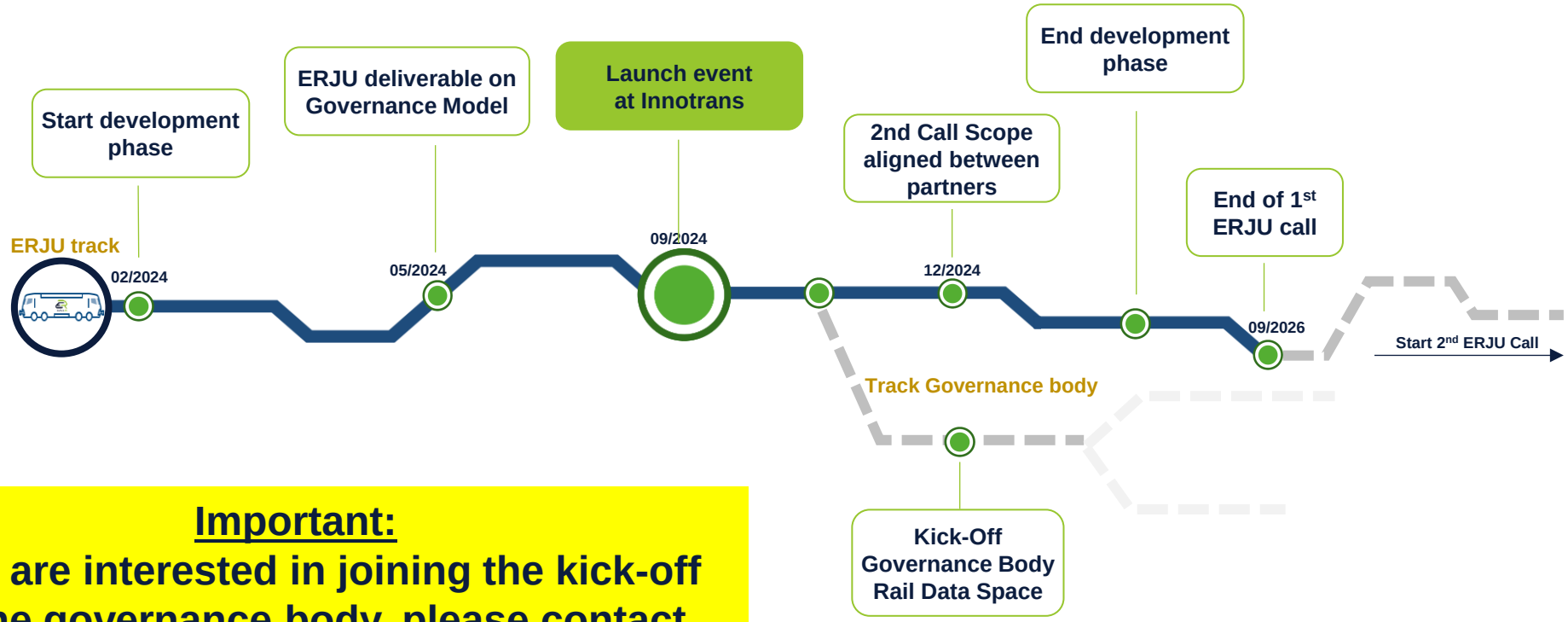
Rail Data Space on track – getting operational!



Important:
if you are interested in joining the kick-off for the governance body, please contact Meike van't Hoen (meike.vanthoen@knorr-bremse.com)

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Thank you very much for your attention!

Are there any Questions?

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- Pierre Tane – International Union of Railways
- Meike vant Hoen – Knorr Bremse
- Pietro Pace – MERMEC SPA
- Andreas Heckmann – Deutsches Zentrum für Luft- und Raumfahrt EV

Passenger Perspective in Rail Transformation

FP1 – MOTIONAL Mid-term event

Delphine Grandsart
European Passengers' Federation
Madrid, 29. October 2024

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Europe's Rail

European Passengers' Federation

We are the voice of public transport users in Europe.

- European association of national and regional passengers' organisations
- 39 member organisations
- 21 countries

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Main objectives

- Advocate passengers' views at EU level
- Promote sustainable mobility
- Improve end-to-end journey experience
- Tackle transport poverty
- Defend better passenger rights
- Always ask '*What's in it for users?*'

European Passengers' Federation

ADOPTING A PASSENGERS' PERSPECTIVE IS ESSENTIAL FOR THE SHIFT TO RAIL

Passengers want:

A public transport system that is

- affordable,
- dependable,
- accessible
- sustainable and
- coordinated

with sufficient capacity to get people comfortably to where they want to go at the times they wish to travel, using whichever combination of modes is most efficient overall, in social and environmental as well as economic terms.

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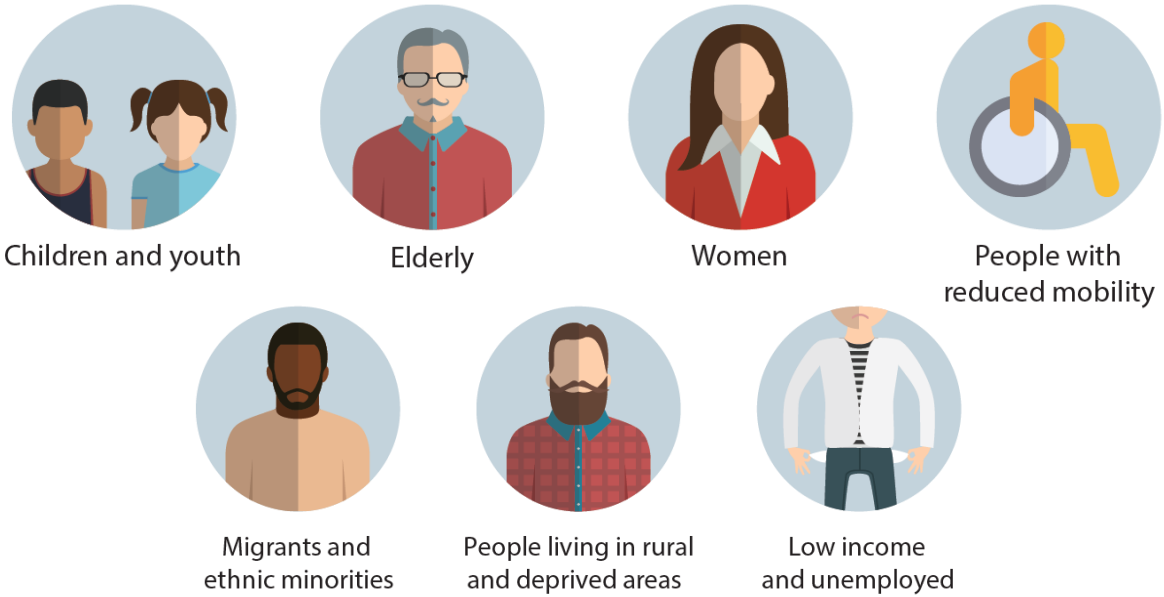
Drivers of mobility behaviour



Source: Maslow's pyramid, applied to public transport (CIPTEC, Peek and van Hagen) (left) - © HiReach project (https://hireach-project.eu/) (right)

Transport is an integrated system

- Infrastructure
- Underlying IT systems
- Timetables & connections
- Information and ticketing
- Passenger rights
- Taxation, funding, price
- …

Integrating rail + other modes

The importance of multimodal hubs

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What if there's a disruption?

Your passenger rights at hand

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European Rail Network and Mobility Management

European Passengers' Federation

Thank you

Delphine Grandsart, Senior Researcher
delphine.grandsart@epf.eu

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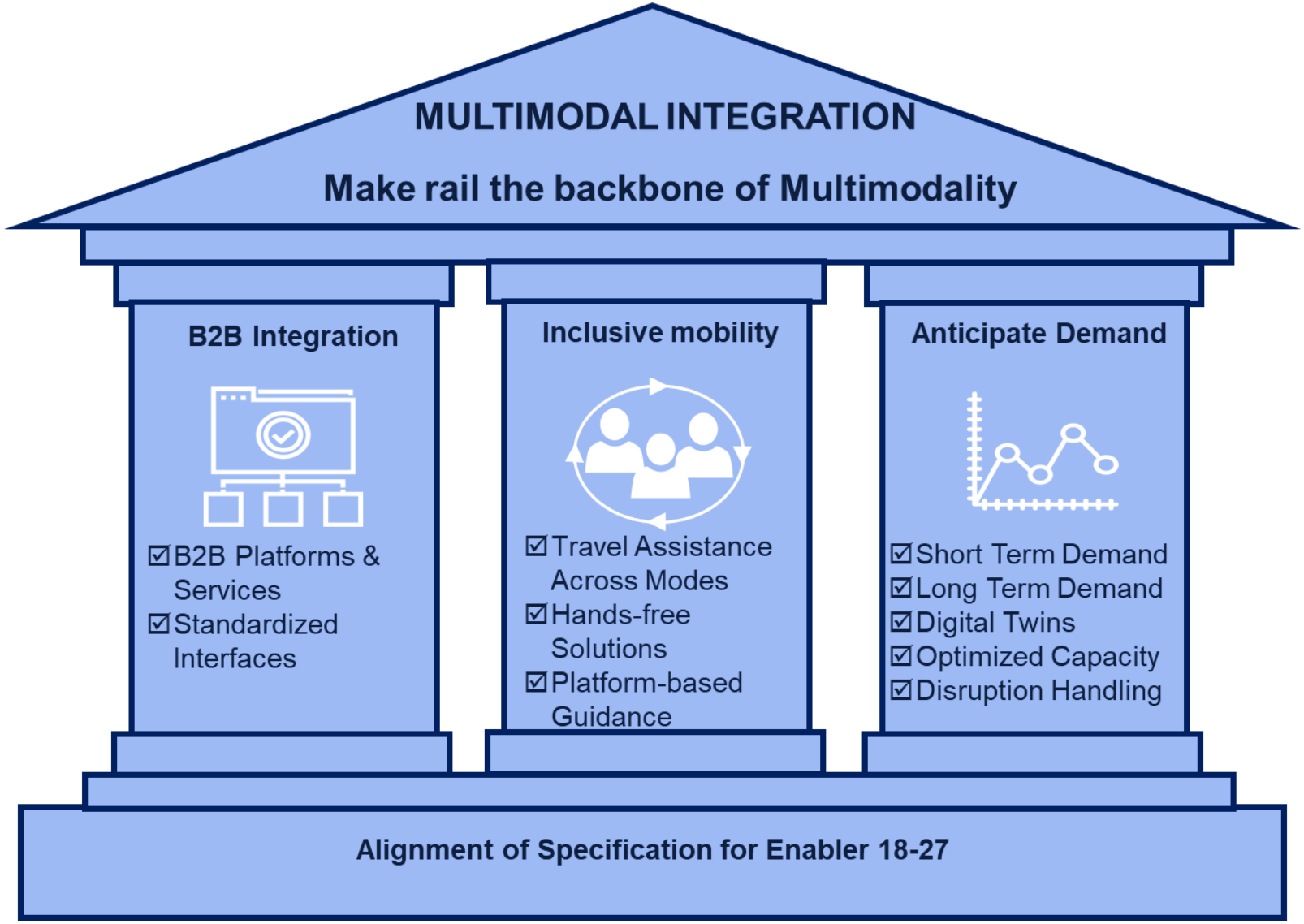
WS1.3 – Rail & D2D Mobility

Laurent Bellet

GTSD

WS1.3 – Multimodal Integration | Context



Make Rail the Backbone of Multimodality

WS1.3 – Multimodal Integration | Achievements

Kick-off & Preparation

- Q4 2022. Preliminary project kick-off
- Q1 2023. Detailed analysis of the 9 enablers part of EU-RAIL Multi-Annual Working Plan from B2B Rail Integration to Travel Assistance, Demand Forecast, Capacity Optimization and Disruption Management
- Q2 2023. Review of Status Quo, baselines, knowledge transfer from previous projects. Definition of a shared engineering approach

Specification

- Q3 2023.
  - Delivery of use cases. A total of 54 use cases responding to the 9 enablers
  - Definition of system requirements, component architecture, data flows, interfaces
- Q4 2023. Delivery of WS1.3 specifications

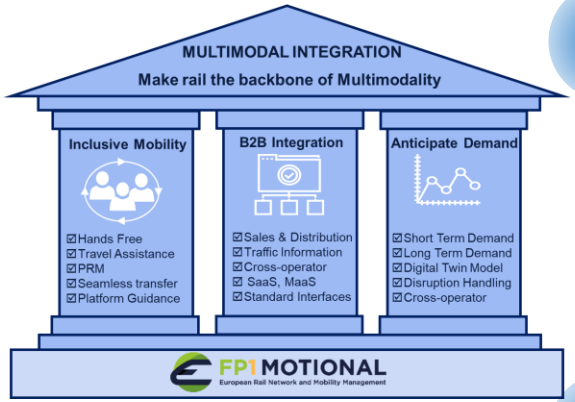
Development

- Q1 2024.Refinement of architecture, detailed design of components
- Q2, Q3 2024. Development of components (software, hardware, interfaces)
- Q3, Q4 2024. Iterative Integration and Testing including scenarios mapped to use cases and technical enablers
- Q4 2024. Early version of development reports (due delivery Date November 2024)

Demos

- 2023. Early vision of demonstrations, a total of 16 demonstrations in live areas (stations, mobility hubs).
- 2024. Framing of demonstration strategy, preparation of demonstration use cases, identification of data inputs, early demonstrations at INNOTRANS.
- Q1 2026 Demonstration execution

WS1.3 – Multimodal Integration | Challenges



Close developments. Finalize developments, especially for hardware parts deployed as part of the demos

Refine demo plans. Detail storyboards, participants, required data and timelines

Deliver TRL. Technical Readiness Level shall meet the ones specified for the enablers

Put in place interfaces. As part of the demos, between WS1.3 demos and other FP.

Deliver demonstration events. Includes live demos with end-users and results dessimination.

Thanks for your attention!

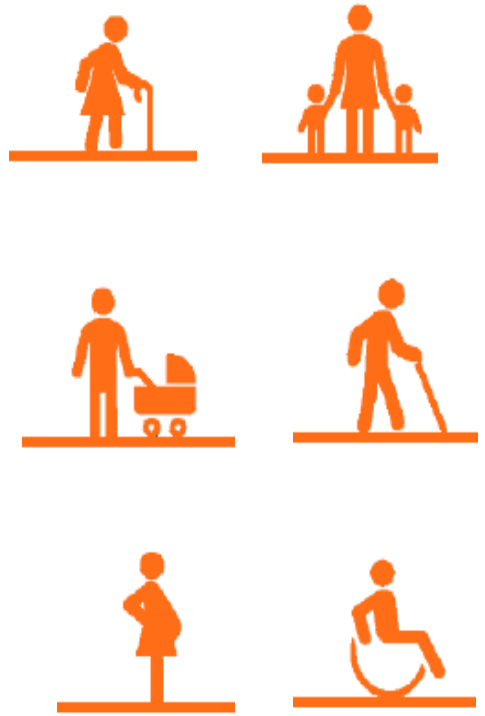
Transforming Rail Travel with Door-to-Door Mobility Integration

Victoria Guryn - RENFE

Juan Manuel Castro – INDRA SISTEMA SA

Norman Offel - HACON

TOTEM T-Ais
Accessible information in real time



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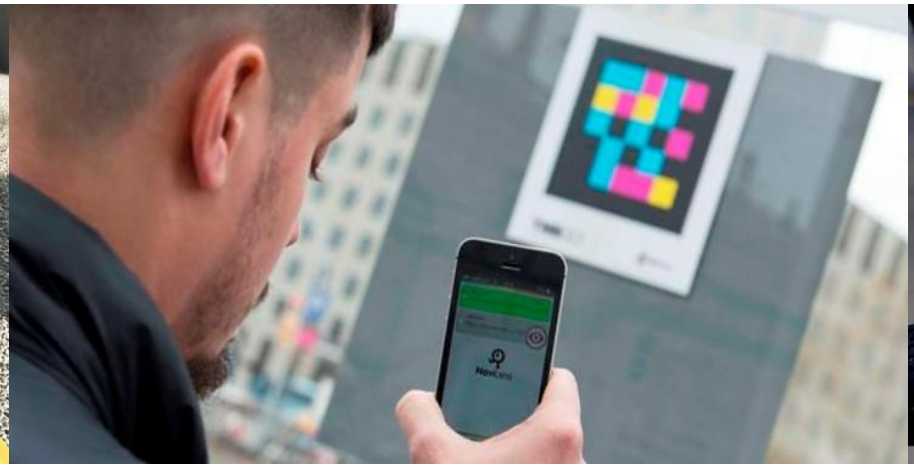
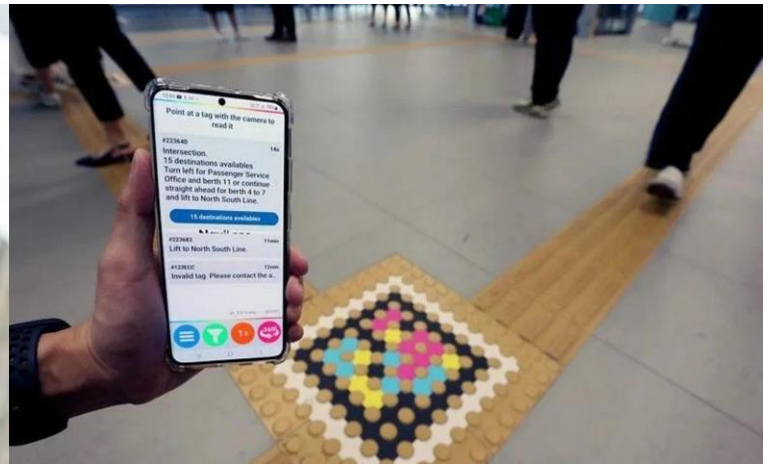
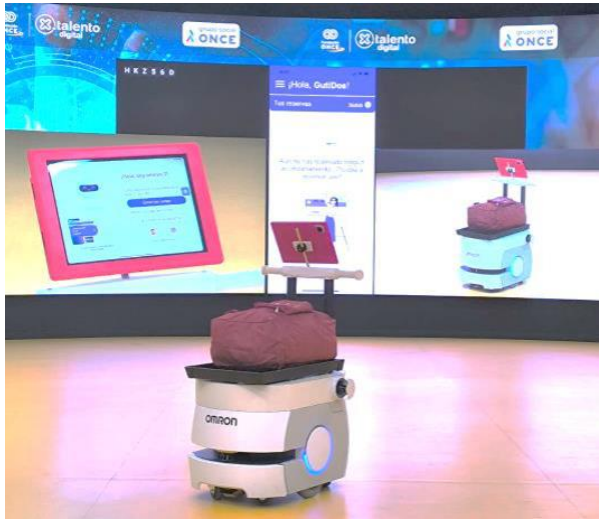
Accessible Train Car Location by Light Projection

Tactile Pathways and NaviLens: Enhancing Station Accessibility





Accessible robot assistance for persons with special needs



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Gap Filler – saves the gap between rolling stock and platform

Reference: https://acosta-ing.com/plataforma-gap-filler/ (ACOSTA INGENIEROS - DELKO RAIL)

FP1 MOTIONAL Mid-Term Event

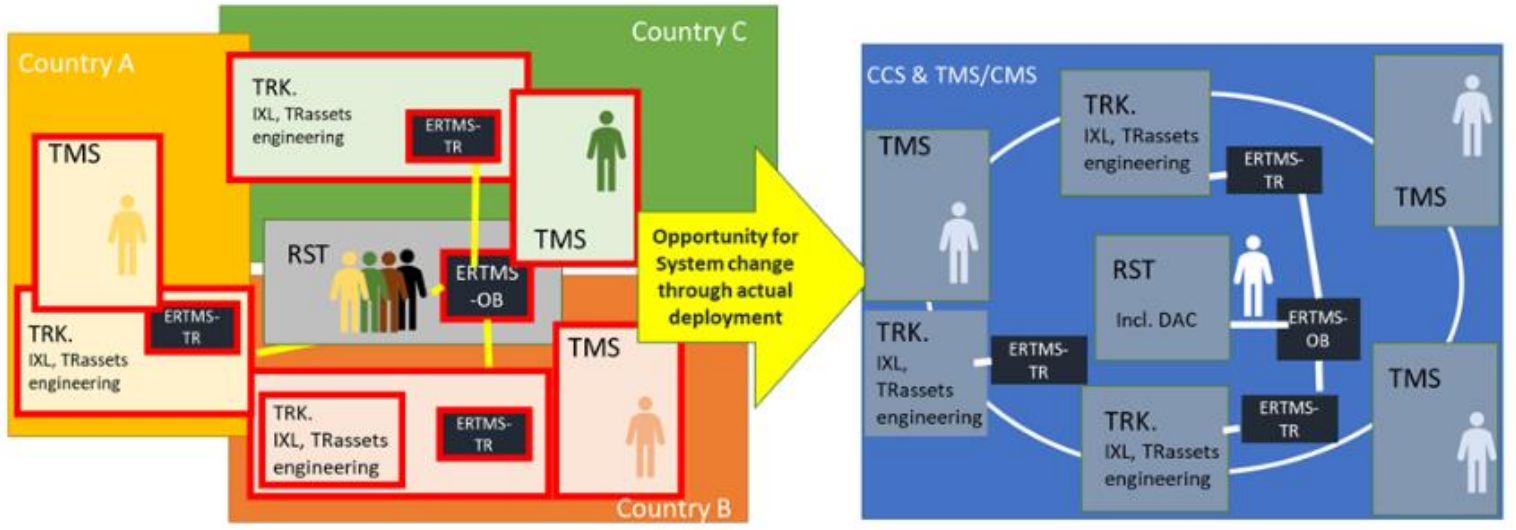
System Pillar

- The System Pillar is the “generic system integrator” for the Europe’s Rail Joint Undertaking (EU-Rail), and the architect of the future EU’s railway system.
- Whilst most individual railway systems have views of the future railway architecture, there is no common EU railway system view that is used today. **The problem with this is that innovations and changes to the system are very difficult and costly to achieve**.
- System Pillar is the opportunity for the sector to converge on the evolution of the railway system – operational concept and system architecture.

System Pillar
4 Years Program

~ 400 *experts from Sector*

Cost: 50 *m EU funded*



Goals

Rail as integral part of mobility services and intermodal transport

Cost efficiency: integration, maintenance and evolution

Increase Performance and interoperability.

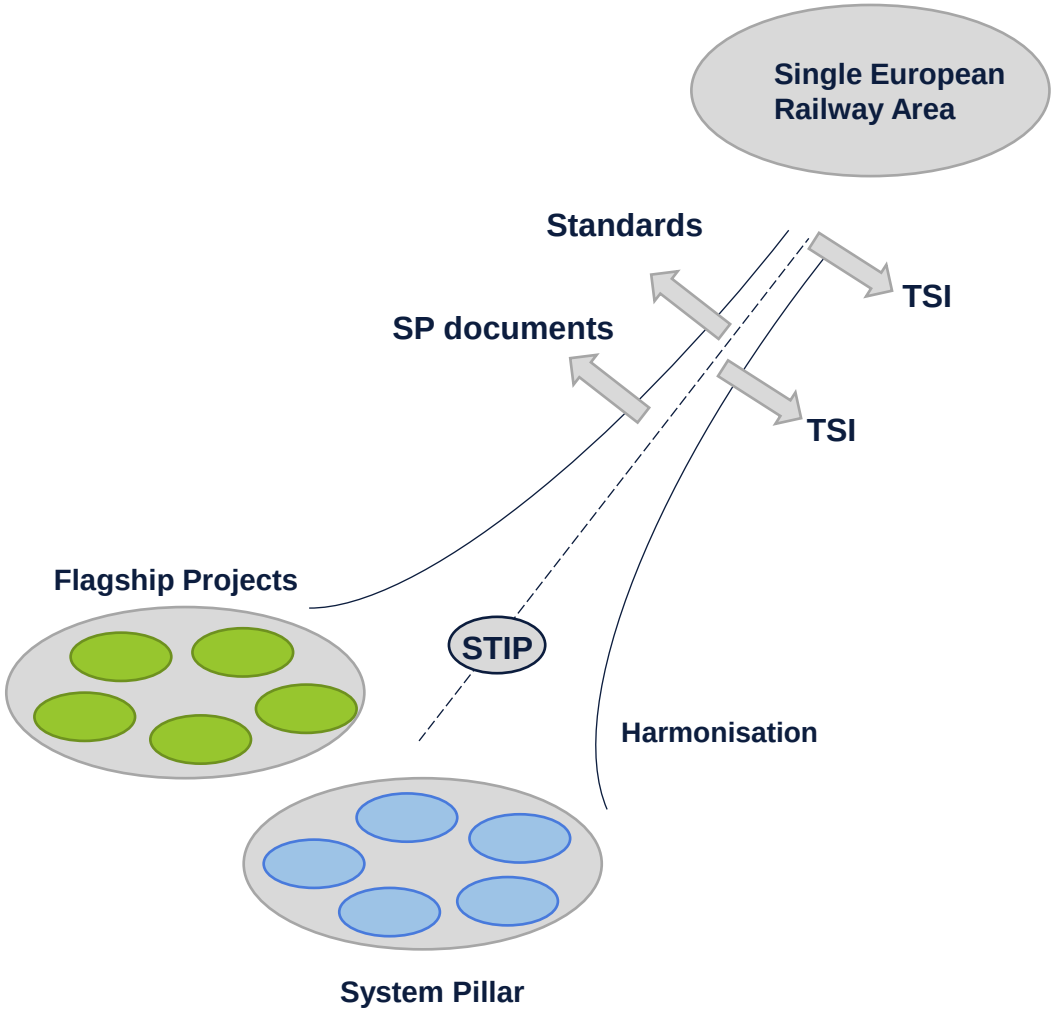
Strengthen the market with large scale, **Support** European rail industry **Competitiveness.**

Standardisation and TSI Input Plan: Context and goal

- The transfer of R&I results of EU-RAIL to the EU standardisation and regulation process is a crucial goal for EU-RAIL.

- Such harmonisation plays a crucial role in providing a future oriented legal framework and in ensuring a consistent standardisation system.

- The STIP
  - Provides a public overview of the outputs of EU-RAIL and their link to harmonisation
  - Addresses a lesson learned from the Shift2Rail programme that the R&I process should be aligned with the standardisation and regulatory processes
  - Will be a significant input to the DG MOVE mandate to ERA on the TSI revision and the DG MOVE request to the European Standardisation bodies.



Collaboration SP – MOTIONAL

Excellent collaboration, marked by regular, open and transparent exchanges.

Starting since the SP ramp up, including more than 25 meetings last year

Main topics of interaction:

Interface TMS with ATO and signalling systems

defining an interface that maximises the **increase of overall system performance**

Cross border CMS and TMS

strengthening future **European** railway system

The system pillar works on designing the evolution of railway systems and integrating the most innovative solutions.

Successful collaboration with the Motional project allows us to engage with **experts who develop** these innovative solutions and collaborate to achieve **specifications backed by validation in demonstrators**

Let's keep collaborating!

WS1.1 - Planning

Magnus Wahlborg

TRV

WS1.1 – Planning | Context

Create the future railway processes

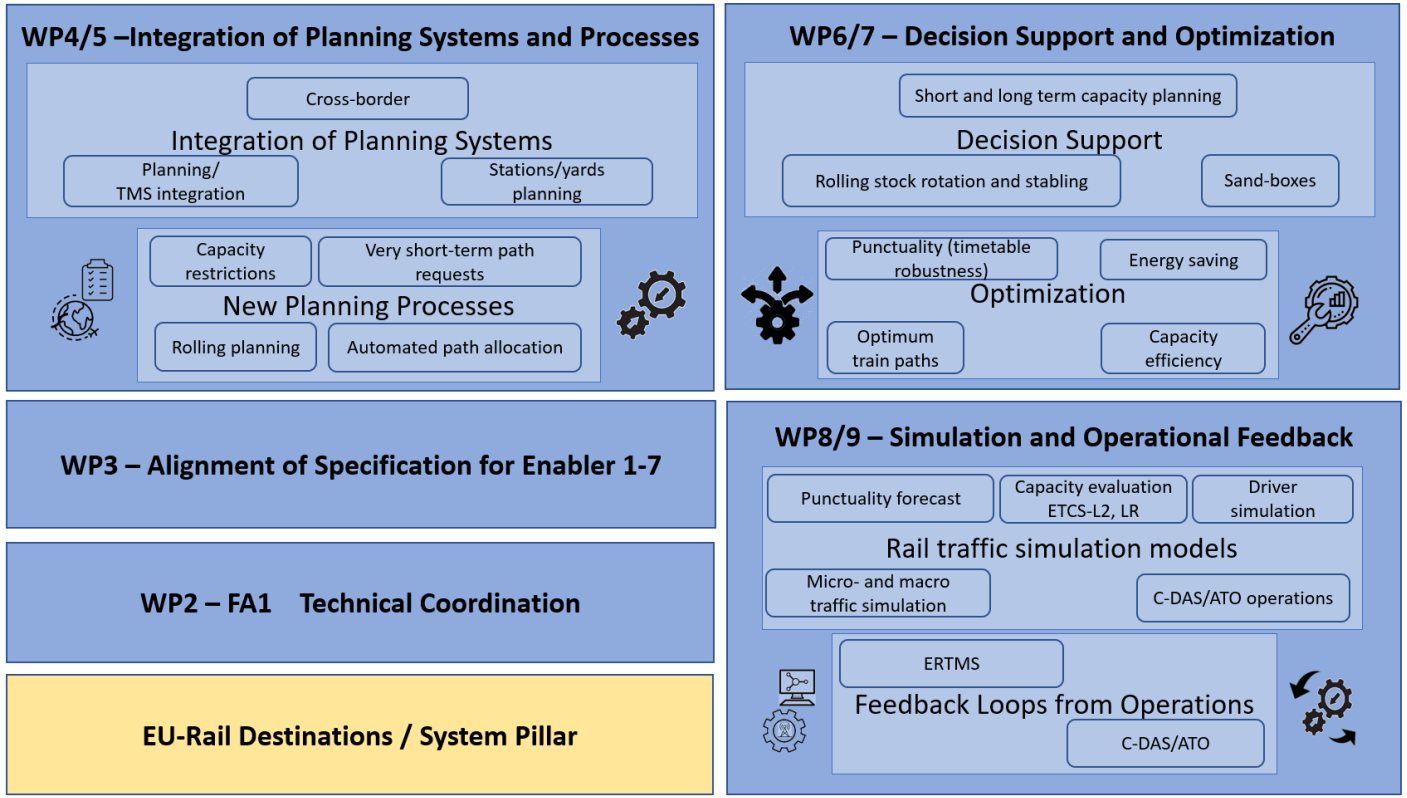
- Planning systems Integration
- Cross-border traffic

Optimise timetables and develop advanced algorithms.

- Decision support modules and algorithms
- Solutions for optimisation: capacity, punctuality, energy, etc.

Simulate operational process

- Feedback loops planning-operation
- ETCS, C-DAS and ATO operations simulation
- Capacity simulation, evaluation and effects of New technologies



WS1.1 – Planning | Achievements reached

Create the future railway processes

Detailed requirements and use cases for:

- Improved capacity allocation and new process
- Integration of traffic management system with network capacity planning
- Integration of network capacity planning with yard and station capacity planning
- Interfaces for interaction with external national or central planning applications

WS1.1 – Planning | Achievements reached

Optimise timetables and develop advanced algorithms.

- Long term timetabling
- Short term timetabling
- Rolling stock planning

Developed methods and models for evaluating feedback loops between planning and operations

- Develop simulation methods for micro and macrosimulation
- Develop methods for analysing historical data from operations for evaluation of capacity
- Conclusions on historical data to produce primary delay distributions

Simulation and operational feedback-connection FP1 and FP2

- FP1 simulate and evaluate capacity effects for New technologies
- FP2 specify and study New technologies (DATO)

Developed simulation methods for Dato techniques (FP2)

- ETCS Hybrid Train Detection System
- Next Generation-Brake System
- Centralized- Driver Advisory System, C-DAS
- Automatic Train Operation, ATO
- Traffic Management System, TMS

WS1.1 – Planning | Challenges

- WP4/WP5 Develop supporting tools/modules for processes that are under development – SystemPillar, RNE and EU legislation
  - Activity - Close dialogue between FP1, SystemPillar and RNE

- Deliver TRL – demonstrations meets Technology Rediness Level specified
  - Activity 1 – define how to evaluate TRL level for demo algorithm/functionality/method
  - Activity 2 – clear and well defined demonstrations and Technical enablers

- Succesful demonstrations
  - Activity 1 – define clear use cases for each demonstration
  - Activity 2 – Well defined activities, template and over all plan for demonstration phase (second phase of motional project 2025 and 2026)

Thanks for your attention!

Improving European Timetables by Algorithms and Simulations

- Dennis Huisman – NS
- Alwin Pot – ProRail
- Isabelle Tardy – Norwegian Railway Directorate

WS1.2 - Operation

Christian Esposito

STS

WS1.2 – Operations | Context

Technical Integration with external TMS and other actors or systems

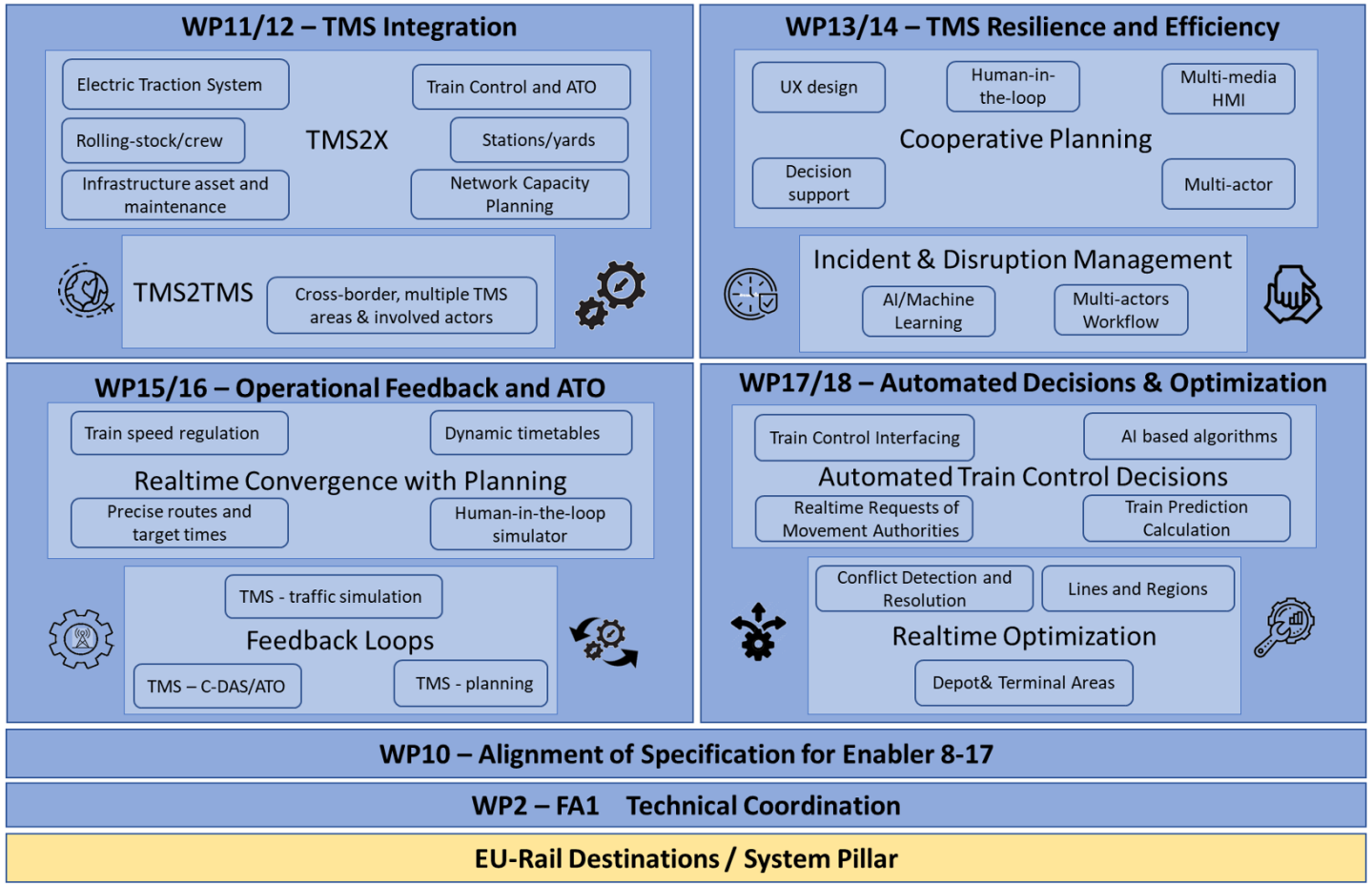
- TMS2X and TMS2TMS integration/collaboration
- Interoperable data description

Improved resilience and efficiency

- Human factors to reduce operator mental workload and stress
- Decision Support System specifying tasks to be automated to increase resilience and efficiency
- Disturbance/disruption management

Improved Automation

- C-DAS and ATO operation
- Energy and capacity optimisation



WS1.2 – Operations | Achievements

Demonstrators' Definition

- Prepare and deliver the high-level specification of requirements, design and use cases based on a state-of-the-art analysis undertaken based on 10 technical enablers
    - Integration of TMSs and processes including cross-border traffic management (WP11/WP12),
    - Improved resilience and efficiency of disruption management (WP13/WP14),
    - Linking TMS to ATO/C-DAS for optimised operations (WP15/16) and
    - Automated decisions and decision support for traffic management optimisation (WP17/WP18).

- Describe all the 25 demonstrations in Workstream 1.2 (some also divided into sub-demos), together with a mapping against their related high-level use cases, technical enablers and requirements, considering alignments and interactions with other FP1 WPs, other Flagship Projects and SP made possible with periodic interactions and meetings.

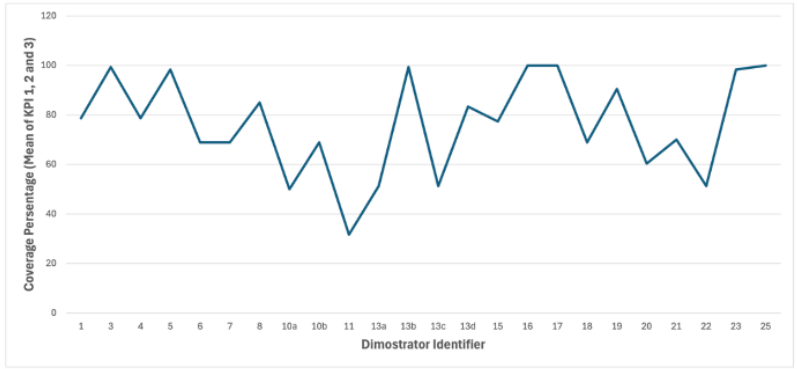
WS1.2 – Operations | Achievements

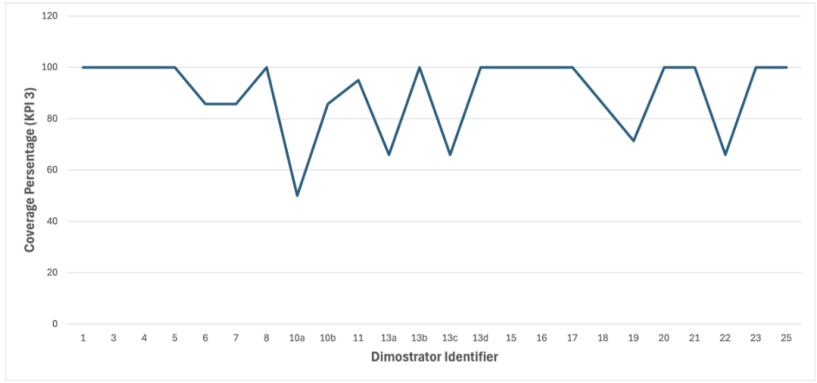
Interoperable Data Modeling

- 20, out of the 25 demonstrators in the Workstream 1.2, have been described in terms of their architecture and functionalities of the hw/sw components, and the data elements exchanged among these elements have been modelled in terms of domains, data structures and relationships.

- Each of the collected data specifications have been compared and mapped with respected to the SP TCCS model by highlighting the covered domains, data elements and properties.

- Per each demonstrator, a set of KPIs have been quantitatively and qualitatively computed so as to have a view of the suitability of the SP TCCS model to be properly used in the demonstrator by substituting the legacy model designed by the involved partner.





WS1.2 – Operations | Achievements

Integration of TMS with other systems

- The specification of processes and communication requirements with regards to data elements needed for an interoperable data exchange of TMS with other systems has been completed.

- The specification and development of appropriate interfaces among the different clients and stakeholders and applications in the different TMS areas including cross-border and integration of TMS with yard/station and trackside energy management systems as well as crew and rolling stock planning and management systems have been done.

Efficient disruption management

- The main use cases for disruption management within the context of railway infrastructures has been described and delivered, including the involved actors, pre-conditions and post-conditions, interactions for use case implementation, the exchanged data structures, and a table of the functional and non-functional requirements.
- The methodology for the design of Human Machine Interaction and the design and implementation of the Decision Support System for disruption management have been delivered together with a workflow for the negotiation and management of decisions between actors with different responsibilities.

WS1.2 – Operations | Achievements

Integration of TMS with ATO/C-DAS

- The current situation both as "state-of-the-art" and "state-of-practice" concerning the link between TMS and ATO/C-DAS has been studied and the important concepts and standards that are evolving in the area, like SFERA, ERTMS\ATO “subsets”, and the RCA as well as the implementation experiences done in several countries (both trial and “real”) of C-DAS and ATO operations have been collected and analyzed.

- The interactions between the main system components of TMS – ATO-TS – ATO-OB, including C-DAS, have been modelled and implemented by means of an Integration Layer (IL) based on the SP TCCS model for exchanging messages between the TMS and ATO-TS.

- A Human-in-the-Loop (HITL) simulation environment has been made to test full TMS/ATO-TS/ATO-OB operation, including feedback control loops and human factors (HF) using HMIs for drivers and traffic management/control operators. HF research requirements and a toolkit have been developed to study train drivers and traffic management/control operators within a TMS–ATO environment.

WS1.2 – Operations | Achievements

Automated Decisions and Decision Support for Traffic Management optimisation

- Functional, non-functional, and operational requirements for a system providing automated decisions and decision support for traffic management optimization have been systematically specified.

- Various algorithms have been designed and developed to advancing the state-of-the-art in traffic management optimization for the specific use cases, and a comprehensive set of criteria for benchmarking the effectiveness and robustness of developed algorithms in real-world applications have been established.

WS1.2 – Operations | Challenges

Challenges (e.g.)

- SP TCCS model is in a continuous improvement and versioning loop:
  - Activity - Close and periodic alignment meeting with the SP as well as WP27

- The work in each WP is related with what is done in other WP in Workstream 1.2 as well as WP6 in FA2 responsible for ATO / CDAS and TMS-ATO Topics, or the WP44 / WP13 responsible for Moving Block in FA 2, and WP3 of IAM4RAIL in FA3.
  - Activity 1 - Exchange of documents and alignment among WPs in FA1,
  - Activity 2 – Interactions with key people working for WPs in FA2 and FA3

- Different artifacts to be delivered as demonstrator, where the definition of TRL may have a different interpretation / validation
  - Activity 1 - define how to define TRL for demo algorithm/functionality/method, software artifact and HMI methodology
  - Activity 2 – clearly specify the TRL validation means

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Thank you very much for your attention!

Are there any Questions?

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Boosting Rail Efficiency with Automation Technologies

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