

ANNUAL ACTIVITY REPORT 2025

EXECUTIVE VIEW

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ANNUAL ACTIVITY REPORT
2025

EXECUTIVE VIEW

The Europe's Rail Joint Undertaking (EU-Rail) became the legal and universal successor of the Shift2Rail Joint Undertaking (S2R JU or S2R). Hence, EU-Rail has succeeded in the management of the S2R JU Research and Innovation Programme.

However, in this report, references may still be made to S2R Programme, S2R Other Members, S2R R&I, S2R Regulation, S2R JU, S2R etc. to identify all the activities and governance inherited by EU-Rail and related to the former S2R JU.

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Foreword



Europe's prosperity and resilience are being tested. We are living in times of geopolitical uncertainty, an accelerating energy transition, new competitiveness challenges and increasingly disruptive impacts from climate change. Against this backdrop, investing in research and innovation to build a sustainable, resilient and competitive European rail system has never been more important.

In 2025, the Europe's Rail Joint Undertaking (EU-Rail) continued to turn ambition into concrete results, bringing together public and private partners to accelerate the transformation of Europe's rail sector.

I am particularly pleased that EU-Rail has expanded its geographical reach, welcoming five new Associated Members from across Europe. Each brings valuable technological and operational expertise, further strengthening the diversity and capacity of Europe's rail innovation ecosystem.

Through its major transformation programmes, EU-Rail is demonstrating how coordinated European action can deliver solutions that would not be possible through isolated efforts. By the end of 2025, more than 70 demonstrations were ongoing or in preparation across Europe, testing innovative solutions in real-world operational environments.

EU-Rail is also helping to create the conditions for the successful deployment of innovation. Through 45 Change Requests on technical specifications for operability submitted to the European Union Agency for Railways, it is supporting greater consistency, interoperability and efficiency across the sector.

These achievements contribute directly to Europe's objectives for sustainable mobility, competitiveness and resilience, while strengthening the foundations of the Single European Rail Area.

The approval of four EU-Rail Flagship Initiatives in December 2025 marks an important milestone towards simplifying rail systems and operations. It provides a strong basis for continuing Europe's rail transformation beyond the current programming period.

Together, we must continue turning innovation into deployment and ensuring that rail plays its full role in building a more sustainable, competitive and resilient Europe.

Magda Kopczyńska,

Director-General for Mobility and Transport, European Commission

Europe's Rail in 2025

The year 2025 was a year of delivery and consolidation for Europe's Rail Joint Undertaking. With the EU-Rail Integrated Programme reaching full maturity after four years of operation, the results now emerging from the Innovation, System and Deployment Pillars demonstrate that this European public-private partnership in the JU model is delivering on its promise. The Programme engaged 377 participant entities from 28 countries. Additionally, with a total of 30 Members, following the integration of five new Associated Members, and full commitment of the yearly budget appropriations for operational activities, EU-Rail confirms that the European rail sector is effectively mobilised to advance the Single European Rail Area.

Over 70 demonstrations were ongoing or under preparation by the end of 2025 and this marks the EU-Rail's Programme transition from research to tangible prototypes testing on rail track. Additionally, early R&I results on infrastructure management – an important recurring cost for the railway system – are already showing increased asset availability and reduced intervention costs, pointing to a significant economic impact of EU-Rail's outputs.

The System Pillar delivered mature specifications that are freely available on the EU-Rail website and already used in procurements. Together with harmonised operational rules and an on-board modular architecture produced and developed by EU-Rail, these specifications lay the groundwork for standardised European solutions that will create economies of scale and reduce system costs. Additionally, the submission of sectorial agreed requests to the EU Agency for Railways (ERA) represents significant cross-stakeholder alignment effort to support future revisions of Technical Specifications for Interoperability.

A major milestone was the formalisation and launch of the High-Level EU-Rail Deployment Group, ensuring that innovations reach the market faster and more cost-effectively. The Group focused its initial activities on the Future Rail Mobile Communication System (FRMCS). The Commission have entrusted EU-Rail to move FRMCS forward, through testing and validation of specifications in its Innovation Pillar, through sector alignment on governance and scope definition of technical specifications with its System Pillar, and through migration planning and deployment recommendations with the High-Level Deployment Group. The results from a comprehensive stakeholder questionnaire, together with analysis of National Investment Plans and the initial development of migration scenarios and cost analysis, provided the insights for EU-Rail to advise ERA on optimising authorisation processes. This stands as proof of the cooperative endeavour enabled in 2025 by the EU-Rail Joint Undertaking framework alongside the European Commission and EU Bodies for policy setting, including safety and interoperability works of ERA, and the rail sector with committed Private Members and beyond.

EU-Rail has continued to support the development of a comprehensive migration strategy to coordinate the deployment of Digital Automatic Coupling (DAC) technology, based on the R&I output of the Programme, which is highlighted as a game-changer for European rail freight in the 2023 Greening Freight Transport communication [1] of the European Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. EU-Rail's support to the European Commission and CINEA for the call under the Connecting Europe Facility resulted in the Pioneer DAC project – a concrete step from research towards first commercial deployment.

1 https://transport.ec.europa.eu/system/files/2023-07/COM_2023_440.pdf



Clear support from DG MOVE and the private Members for a next rail JU, further echoed at the European Parliament.

Building on the reflection process started in 2024 on the future of the JU, in June 2025, the Governing Board adopted the High-Level Paper entitled "A Future Policy-Based Public-Private Partnership for Rail," [2] confirming the need of a new rail JU. The Membership came together to call for a coordinated EUR 18 billion investment strategy for 2028–2034 to simplify and modernise Europe's rail system, making intelligent use of future FP10, ECF, private and possibly also national financing. With a mission centring on simplifying rail systems and operations while enhancing fundamental capabilities to strengthen the Single Market and deliver a harmonised Single European Rail Area, the associated annexes outlining four Flagship Initiatives aligned with the European Commission strategy were approved [3] in December 2025.

Also in December 2025, the General Assembly confirmed clear support from DG MOVE and the private Members for a next rail JU, further echoed at the European Parliament during the Rail Forum Europe roundtable in January 2026, where MEPs expressed strong interest in supporting the legislative process for a successor rail Joint Undertaking.

The direct commitment from the CEOs of all private Members to continue and increase their engagement, together with several letters of support addressed to European Commissioners from the sector associations, confirmed the shared ambition and long-term alignment underpinning the successful results of this partnership.

The JU's Membership was further strengthened in 2025 with the integration of five new Associated Members: Acciona (Spain), Frequentis (Austria), Infraestruturas de Portugal and the Alliance (Portugal), Kontron (Austria), and XLAB D.O.O. (Slovenia and Spain), each bringing their unique expertise in key technological and operational areas and expanding the geographical reach of the EU-Rail.

The EU-Rail Research and Innovation activities are designed to deliver concrete solutions to answer the needs of passengers and the supply chain, not only to contribute to the European Green Deal but also to address the energy transition and the new competitiveness challenges facing Europe. The evolving geopolitical context, including the strategic importance of railway infrastructure for European security and defence, further underscores the need for a resilient, competitive and harmonised European rail system, and the JU Programme Office and its Members are well aware of this urgency and of the importance that the work of the Integrated Programme carries.

Building on openness and inclusiveness, the mission-oriented nature of the JU answers the call of the Member States and Parliament to deliver impact and added value to European citizens. **Synergies with other European Union initiatives, as well as national and regional programmes and partnerships, continue to provide opportunities to complement the series of actions expected from the rail sector.** Stakeholder relations, communication and dissemination of results ensure the visibility and uptake of the progress achieved. Sound financial and risk management and compliance underpin the implementation of the Programme along its lifecycle. The cohesion that EU-Rail has created within the European rail industry builds upon a small team of passionate professionals fully committed to deliver this ambitious Integrated Programme.

As the Executive Director of Europe's Rail, I would like to express my gratitude to all EU-Rail Members, the EU-Rail staff, the Member States representatives and the observers for their collaboration and support during 2025, making these significant results possible.

2 https://rail-research.europa.eu/wp-content/uploads/2025/06/GB-Decision_06-25_High-Level-Paper-on-future-rail_v1.pdf

3 https://rail-research.europa.eu/wp-content/uploads/2025/12/Annex_GB-Decision_10-25_High-level_Paper.pdf



Giorgio Travaini,

Executive Director of the Europe's Rail Joint Undertaking

2025 in Figures

€284.9 million

Total value of ongoing projects in 2025



25

Grant agreements signed (from the beginning of the programme)

379

Total engaged unique participants by 2025

28

Total countries involved by 2025

2* Calls launched in 2025

€4.6 million
Total value of projects launched in 2025

€2.9 million
EUR funding awarded in 2025

19
Beneficiaries in funded projects

6
SME participations that were part of the evaluated proposals in the 2025 call

6
SME participations that were included in the proposals retained for funding

*Since the grants resulting from Call HORIZON-JU-ER-2025-02 were evaluated and awarded at a later stage in 2026, the detailed funding figures related thereto will be presented in the Activity Report 2026. All the data reported above concern Call HORIZON-JU-ER-2025-01 only.

Executive Summary

The Research & Innovation activities performed under the new EU-Rail Integrated Programme cover innovative solutions lifecycle, from exploratory research to pre-implementation and deployment, are designed to deliver the rail sector transformation needed to answer the needs of clients, passengers and the supply chain. This is important not only to contribute to addressing the European Green Deal but also the energy crises and new competitiveness challenges.

By the end of 2025, after four years of operation, the EU-Rail Programme engaged 377 participant entities across 801 participations from 28 countries, including 55 SMEs and 106 research centres and universities, with 30 Members in total following the integration of five new Associated Members.

In 2025, the outputs established as part of the System Pillar work included:

- Second version of Standardisation and TSI Input Plan.
- System concept for the Traffic Control System.
- Train control system architecture.
- Cybersecurity specifications V1.0.
- Trackside Assets specifications update (TACS/EULYNX Baseline 4 Release 4).
- System Pillar report on FRMCS Version 2 and Version 3.
- Submission of 45 Change Requests to the ERA Change Control Management Database.

Finalised specifications are freely available on the EU-Rail website and can be used by the sector in procurements, supporting cost reduction and strengthening the harmonisation of the railway system. Significant achievements include the production of system concept for future harmonised operational rules and associated CCS specifications essential for achieving the Single European Rail Area, the development of an on-board modular architecture including Ethernet Consist Network and enhanced train interfaces, and the extension of the CCS/TMS data model as part of the ERA ontology.

Under the Innovation Pillar, following the launch of the first six Flagship Projects in December 2022, activity monitoring and results assessment continued in 2025 in view of fulfilling the main milestones ahead of their conclusions in 2026. Over 70 demonstrations were ongoing or under preparation across the programme by year-end, including critical demonstrations in real operational environments such as Digital Automatic Coupling (DAC) testing under winter conditions in Sweden with demonstrator trains running in commercial service, Automatic Train Operation Grade of Automation 4 (ATO GoA4) in the Czech Republic, remote train operations and a pilot Energy Hub in the Netherlands, Moving Block demonstration in Germany, robotic prototypes for trackside ERTMS equipment



installation, and Digital Twin and predictive maintenance solutions. The results expected from this first wave of Flagship Projects will constitute the basis for the continuation of the technological developments in the next phases of the programme. Additionally, in 2025, EU-Rail monitored the activities of:

- five projects embedded in the Flagship Areas, including two projects launched in 2024 in synergy with the European Smart Networks and Services Joint Undertaking (SNS JU) and the SESAR 3 Joint Undertaking;
- 12 Exploratory research projects, complementing the work of the Flagship Projects in often different areas of research and innovation of the EU-Rail Innovation Pillar. Two of these exploratory projects were successfully concluded in 2025 (RAIL4CITIES and ESEP4Freight).

Two new Grant Agreements were signed (stemming from the 2024-01 and 2025-01 calls for proposals) and EU-Rail launched two calls for proposals in 2025 to ensure appropriate programme implementation. Call 2025-01, launched in February, advanced the development of Maglev Derived Systems and their feasibility for the European railway network, with the new MaDe4Rail 2 project already running following a grant agreement finalised in November. A new Grant Agreement was also signed under Flagship Area 5 "Sustainable Competitive Digital Green Rail Freight Services" on Digital Automatic Coupler. Call 2025-02, launched in October, covered 16 topics including the second wave of Flagship Projects – defining the next steps towards large-scale demonstration at higher Technology Readiness Levels – as well as four new exploratory projects, paving the way for the deployment of innovative operational and technological solutions across Europe.

Deployment activities are also a central activity of EU-Rail. During 2025, following the Governing Board Decision No 11/2023, EU-Rail formally set up the High-Level Deployment Group. Three meetings in 2025 included formal decisions on procedures and key topics, FRMCS (Future Rail Mobile Communication System) was agreed as a first subgroup focus. A comprehensive FRMCS questionnaire gathered valuable insights from key stakeholders, revealing notably different timelines foreseen for infrastructure managers and railway undertakings or lessors, limited awareness in smaller countries and companies, and the need for a future-proof and stable system. In addition, the European DAC Delivery Programme under the leadership of EU-Rail has continued to bring together the rail sector beyond the Membership to bridge the research work with innovation, including migration planning, towards the deployment of a European DAC solution, built on open and transparent standard specifications.



EU-Rail Programme Status

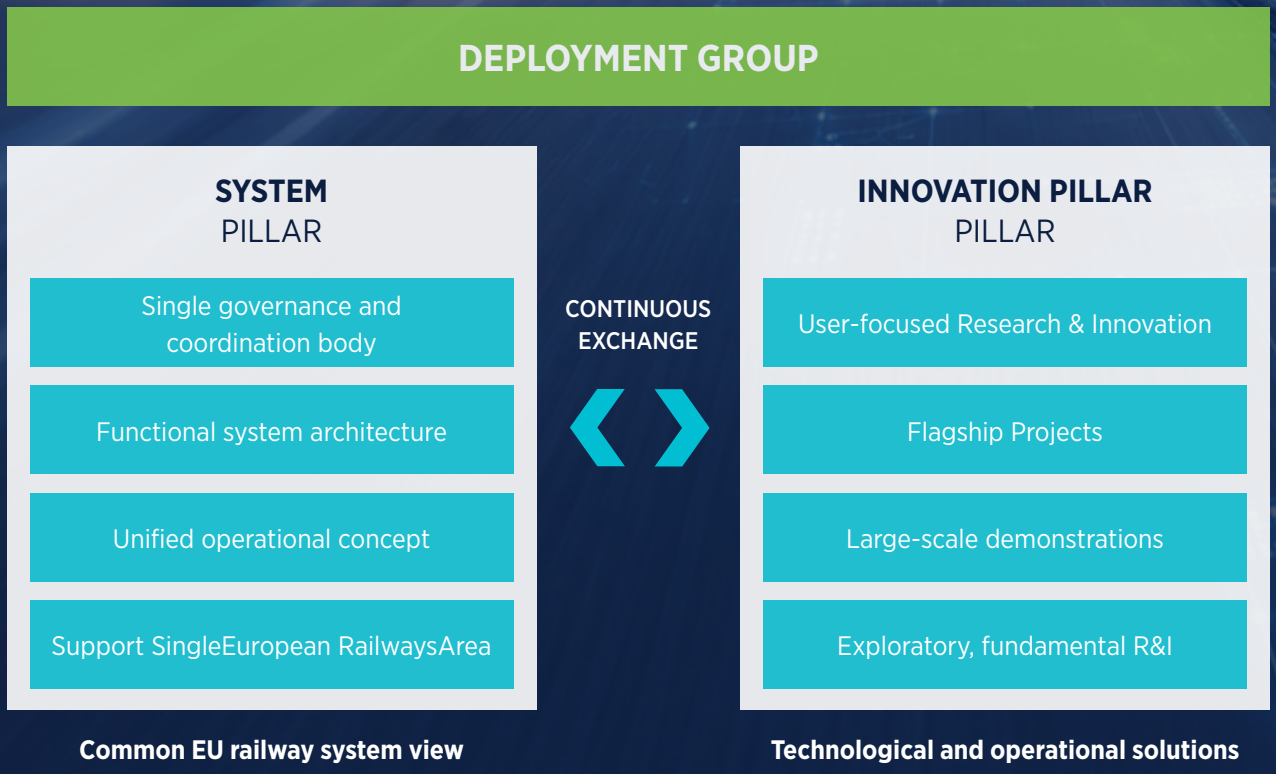
EU-Rail officially kicked off in 2022, taking the legacy of the successful work delivered from 2016 to 2024 by Shift2Rail. That same year, a framework was set up to enable regular collaboration between the System Pillar and Innovation Pillar as part of the Integrated Research and Innovation Programme.

By 2023, this set up was fully up and running, making it possible for both pillars to actively exchange input and ideas based on a shared set of priorities and goals.

The EU-Rail structure was then completed in 2025 with the implementation of the Deployment Group.

In 2025, implementation of the Integrated Programme continued, centred around the following objectives:

- contribute to achieving the Single European Railway Area;
- ensure a fast transition to more attractive, user-friendly, competitive, affordable, easy-to-maintain, efficient and sustainable European rail system, integrated into the wider mobility system;
- support the development of a strong and globally competitive European rail industry.





DELIVER AN **INTEGRATED EUROPEAN RAILWAY NETWORK** BY DESIGN

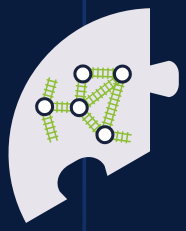
DEVELOP A **UNIFIED OPERATIONAL CONCEPT AND A FUNCTIONAL SYSTEM ARCHITECTURE** FOR INTEGRATED EUROPEAN RAIL TRAFFIC AND CCS/AUTOMATION

DELIVER A **SUSTAINABLE AND RESILIENT RAIL SYSTEM**

DELIVER A **COMPETITIVE, GREEN RAIL FREIGHT** FULLY INTEGRATED INTO THE LOGISTICS VALUE CHAIN

DEVELOP A **STRONG AND GLOBALLY COMPETITIVE EUROPEAN RAIL INDUSTRY**

The System Pillar



The System Pillar is the "generic system integrator" for EU-Rail, and the architect of the future EU's railway system. It is established under the Single Basic Act as a fundamental activity of EU-Rail, alongside the Innovation Pillar and Deployment Group.

It provides governance, resources, and outputs to support a coherent and coordinated approach to the evolution of the rail system and the development of the system view, based on a formal functional system architecture approach to speed innovation and deployment.

The System Pillar **tasks and domains** are:

- **Horizontal domains** – Engineering Environment Team (EET), Performance, Reliability, Availability, Maintainability and Safety (PRAMS), and Security;
- **Task 1:** Railway System;
- **Task 2:** Control-Command and Signalling (CCS);
- **Task 3:** Capacity Management System (CMS) and Traffic Management System (TMS);
- **Task 4:** Digital Automatic Coupling (DAC) and Full Digital Freight Train Operations (FDFTO) System Design;
- **Task 5:** Harmonised European Railway Diagnostics.

The scope and achievements of the System Pillar tasks and domains in 2025 were:

Horizontal domains

The horizontal domains deliver methods, tools and training for the whole System Pillar. Progress and results achieved in 2025:

- **EET:** Strengthened the System Pillar engineering framework through SEMP v4, improved traceability requirements, an aligned SP Glossary, and enhanced Capella–Polarion integration and tooling.
- **PRAMS:** Advanced the harmonised safety framework through the EU Hazard Database, improved risk assessment and safety guidance, Design Safety Case and Evolution Management approaches, HOF evaluations, CMB requirements/KPIs, and EGNOS support.
- **Security:** Finalised and secured SP-STG approval for the core cybersecurity framework, establishing harmonised requirements, interoperable interfaces, and lifecycle guidance for secure railway systems.

Task 1: EU Railway System

The main ambition for the Task 1 System Levels is to identify the necessary and important improvements in selected interaction processes (business, technical and operational) (for a better "to-be" architecture).

Progress and results achieved in 2025:

- Progressed the to-be architecture for the Maintain and Monitor Infrastructure Capability and the Maintain and Monitor Rolling Stock Capability.

Task 2: CCS

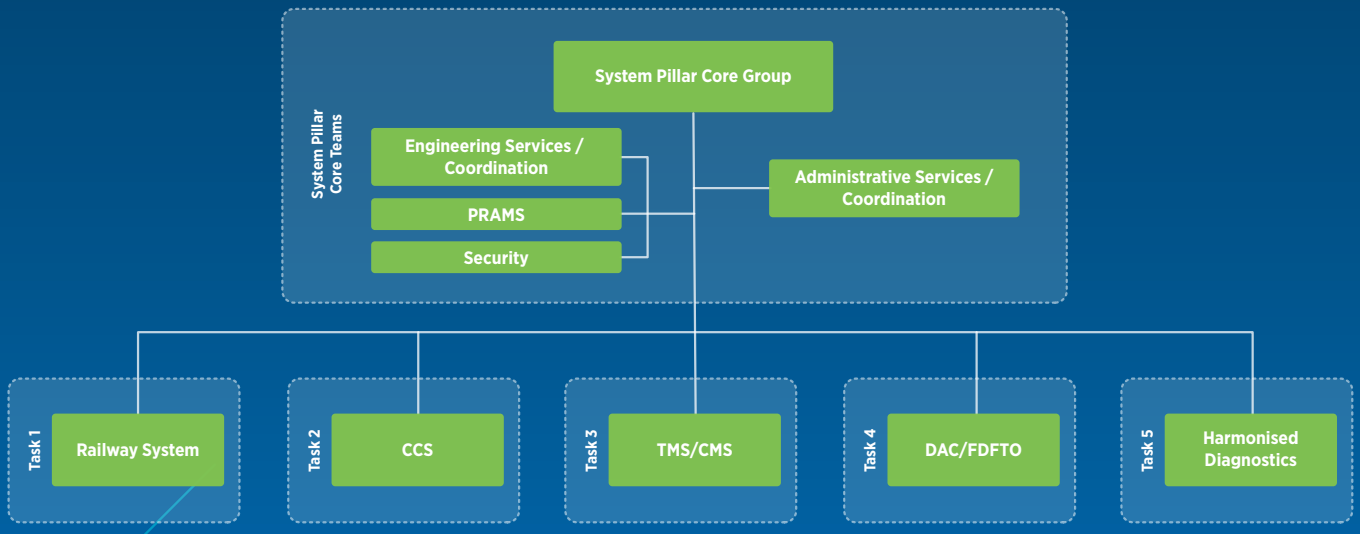
Task 2 develops the operational concept(s) and functional system architecture for a genuine integrated European CCS system, supported by a model-based systems architecting and engineering approach, beyond the current specifications in the CCS TSI, with much greater standardisation and much less variation than at present.

Task 2 is structured by domain teams:

- Cross-cutting activities:
  - The Operational Design Team;
  - The Architecture and Release Coordination Team;
  - The Migration and Roadmap Team.
- (Sub-)System Design activities:
  - The Traffic Control and Supervision Team;
  - The Trackside Assets Control and Supervision Team;
  - The Train Control and Supervision Team;
  - The Transversal CCS Components Team;
  - The Communications Team;
  - The Computing Environment Team.

Progress and results achieved in 2025:

- **Architecture and Release:** Developed granularity concepts and principles, System Level 3 architecture, and released Version 1 outputs for Innovation Pillar Wave 2 applicants. Completed pre-assessment and problem definitions for 45 Change Requests for the 2026 and 2028 TSI revisions;
- **Operational Design:** Harmonised operational processes covering movement, movement permission revocation, usage restrictions, passenger boarding/disembarking, train departure preparation and approaching stop locations;
- **Traffic CS:** Secured SP-STG approval of the Train CS Architecture; completed the Ethernet CCS Consist Network definition; advanced train interface enhancements, Train Length and Train Integrity, on-board modularity and upgradeability, and EGNOS support.



- **Computing Environment:** Completed system analysis.
- **Trackside Asset CS:** Released the Baseline 4 Release 4 subset.
- **Transversal:** extended the ERA ontology for CCS/TMS and data-model derivation, supported the Interoperability Test Bed, and developed Service Functions Configuration and Diagnosis tools based on the ERA ontology.

Task 3: Traffic Management System/Capacity Management Design Team

Task 3 carries out the coordination and execution of the detailed design work for the lower System Levels 3, 4 and 5 for the Traffic Management System/Capacity Management and defines detailed operational processes and requirements, functional system analysis and technical architecture. This domain is responsible for all planning activities including producing the operational plan and keeping it up to date. The two main areas of activities are Capacity Planning (CMS) and Capacity Production (TMS);

Progress and results achieved in 2025:

- Updated the European CMS/TMS implementation variant analysis;
- Submitted a preliminary GAP analysis comparing the Federated Model with the regulatory framework;
- Updated the TMS–Traffic CS interface deliverable to improve alignment;
- Proposed a preliminary function distribution and harmonisation scope between CMS and TMS, including relevant Use Cases;
- Provided an introduction to digitalisation developments in the draft capacity regulation.

Task 4: Digital Automatic Coupling (DAC), Full Digital Freight Train Operations (FTDFTO)

Full Digital Freight Train Operations (FDFTO), as part of Task 4, covers all cross-cutting activities related to DAC/FDFTO (e.g., regarding operational procedures, architecture and interfaces to embed the on-board system, developed by FP5, into the overall railway system). It also manages the input to the Standardisation and TSI Input Plan (STIP) for DAC/FDFTO, and supports FP5 regarding authorisation strategy.

Progress and results achieved in 2025:

- Maintained work on the European operational rulebook;
- Continued development of the FDFT Central Instance and sector-aligned concept;
- Continued work on Train Length and Integrity with Task 2 and FP2, leading to an aligned draft at the start of 2026.



Task 5: Harmonised diagnostics

The Harmonised European Railways Diagnostics (HERD) brings together representatives of data users and data providers from supplier industry, infrastructure managers (IM), railway undertakings (RU), and vehicle keepers (VK). The team members ensure strong alignment with the Innovation Pillar Flagship projects FP1, FP3 and FP5 as well as with the System Pillar Tasks 1, 2 and 4. This specific topic project was redefined as Task 5 HERD during 2024. This domain is responsible for designing a new standard procedure to harmonise European railway diagnostics. In this way, it will contribute to the creation of the Single European Railway Area (SERA).

Progress and results achieved in 2025:

- Finalised the analysis of two harmonised diagnostics use cases: Track Side Wheel Monitoring, using Wayside Train Monitoring Systems (WTMS), and OnBoard Track Monitoring, using onboard measuring devices on special and commercial vehicles.

The highlights among all 2025 the outcomes were:

- Fourth version of the System Engineering Management Plan (SEMP);
- Second version of the Standardisation and TSI Input Plan (STIP);
- Interaction of the System and Innovation Pillars;
- Publication of the EU-Rail System Pillar CCS/TMS data model as an extension of the ERA Ontology.



The Innovation Pillar



The Innovation Pillar is designed to deliver user-focused research, innovation and large-scale demonstrations. It is tasked to deliver operational and technological solutions with the necessary capabilities to transform the European rail system.

Its activities are structured in seven Flagship Areas and the Transversal Topics, leading to large-scale demonstration as defined in the SBA. This is complemented by Transversal Topics supporting the operational processes and activities of the Flagship Areas and, in particular, their implementation of the related use cases.

In addition, new and disruptive ideas are continuously explored through Exploratory Research activities that challenge traditional approaches and practices, promote behavioural and organisational change, and thus help to accelerate the innovation, scientific knowledge generation and sharing, and the integration of technological advances from other sectors into the European railway system, within a user-centred and multimodal context.

Progress in 2025

Two calls for proposals were launched: Call 2025-01 and call 2025-02 to ensure appropriate implementation of the programme.

- **Call 2025-01** (including one topic), launched in February and focused on the development of Maglev Derived Systems and their potential integration on the European railway network. The Grant Agreement was signed in November and the new **MaDe4Rail 2** project started in December.
- **Call 2025-02**, launched in October, covered ten topics including the second wave of Flagship Projects – defining the next steps towards large-scale demonstration at higher Technology Readiness Levels – as well as four new exploratory projects, paving the way for the deployment of innovative operational and technological solutions across Europe.

In addition, the FP5-DACtiVate Grant Agreement was also signed under Flagship Area 5 "Sustainable Competitive Digital Green Rail Freight Services" on Digital Automatic Coupler stemming from the Call 2024-01.

Flagship Areas and Projects

In 2025, the Flagship Projects (FPs) responsible for undertaking the initial implementation of these Flagship Areas continued their activities. Building on the preparatory work done in 2023 and 2024, all projects have continued working on use cases, defining requirements and developing specifications, while also developing prototypes and initiating testing activities across multiple countries. These testing activities have already provided preliminary insights into the solutions developed within the Flagship Projects. All Flagship Projects have also continued collaborating among themselves, as well as with the EU-Rail System Pillar.



FLAGSHIP AREA 1

Network Management Planning and Control & Mobility Management

The main objective of FA1 is to significantly improve flexibility, efficiency, resilience and capacity adaptation within the European rail network, while enabling the development and operation of a Single European Rail Area.

Currently, FA1 includes two flagship projects: FP1-MOTIONAL and FP1-TRAVEL WISE.

FP1-MOTIONAL, the first project under Flagship Area 1, started on 1 December 2022. Its aim is to pave the way towards a Single European Rail Area through the delivery of functional requirements, associated specifications, and operational and technological solutions to enable a future European Traffic Management and Capacity Management System that will make rail the backbone of a multimodal transport system for passenger and freight. Its scope also includes the Transversal Topics (TT), focusing on solutions for digital enablers across all flagship projects, such as Federated Rail Data Space, Digital Twin, Digital Asset Engineering and Conceptual Data Model.

This project is being delivered in two Workstreams (WS):

Workstream 1 addresses the solutions for planning and operations of rail services at the European level (Traffic Management System and Capacity Management System) and the integration of rail services with door-to-door mobility.

In 2025, Workstream 1.1 (Capacity Management) focused on developing solutions for short- and long-term European rail service planning, including the integration of planning systems, cross-border and rolling stock planning, timetable redesign, and the integration of TMS with yard and station capacity planning. The workstream also developed and implemented algorithms for timetabling, rolling stock planning, train path optimisation, and decision support, using operational feedback loops from ETCS Hybrid Train Detection, Automatic Train Operation, and C-DAS. The 28 planned demonstrations progressed from preparation to implementation, covering cross-border planning, decision-support timetabling, and simulation with operational feedback, with validation events planned for Spring 2026.

Meanwhile, Workstream 1.2 (Traffic Management) focused on developing solutions for dynamic, resilient, and integrated European traffic management, including TMS integration, cross-border coordination, disruption management, and TMS–ATO/C-DAS integration. The workstream developed interoperable communication platforms, intelligent decision-support systems, and advanced algorithms for conflict resolution, disruption management, and traffic plan optimisation. It also achieved major advances in TMS-ATO integration over

The 31 demonstrations cross ten European countries progressed to testing with real railway network data, validating solutions from TRL 4 to TRL 8 and supporting the transition towards agile, borderless, and more efficient traffic management.

ERTMS, real-time traffic plan updating, and standardised European interfaces, demonstrating the practical viability of more automated and harmonised railway operations. The 31 demonstrations cross ten European countries progressed to testing with real railway network data, validating solutions from TRL 4 to TRL 8 and supporting the transition towards agile, borderless, and more efficient traffic management.

Finally, Workstream 1.3 (Multimodal Integration) focused on developing solutions for seamless, inclusive, and demand-responsive door-to-door mobility through the integration of rail with other transport modes. The workstream advanced multimodal interfaces for ticketing, financial clearing, journey planning, and disruption management, while validating passenger-centric solutions including digital guidance, MaaS applications, assistive technologies, and accessible platform guidance for persons with reduced mobility. It also developed and validated short- and long-term demand forecasting, analytics, and Digital Twin-based decision-support solutions to improve capacity, passenger flow, and resource utilisation.

Workstream 2 covers the TT topics mentioned above and the summary of WS2 progress in 2025 can be found in the Digital Enablers – Transversal Topic TT section of this document.



FP1-TRAVEL WISE officially started on October 2024. It is the first air-rail synergy project with SESAR Joint Undertaking, aiming to explore solutions for more efficient intermodal operations management and optimised passenger experience.

In 2025, the workstream focused on identifying user requirements, benchmarking existing air and rail technologies, and developing a common architecture and concept of operations for a federated air-rail dataspace. The workstream also established a common glossary across the air, rail, and maritime domains and defined the roadmap and use cases for the Travel Wise solution. In parallel, a methodological framework for demonstration and assessment was developed, including preliminary validation objectives and key performance areas, demonstration scenarios, and initial technical specifications for the solution.

FLAGSHIP AREA 2

Digital & Automated up to Autonomous Train Operations

The objective of FA2 is to take the major opportunity offered by digitalisation and rail operation automation and to develop solutions expected to bring additional functionalities to control command and signalling.

This includes next generation Automatic Train Control (ATC), including Automated Train Operation (ATO) Grade of Automation 4 (GoA4), building upon radio-based European Rail Traffic Management System (ERTMS) or above, representing the next evolution of the system, incorporating the latest technological advances, and with functionalities enabling full optimisation of performance in line with the Traffic Management improvements developed in FA1. FA2 aims at delivering scalable automation in train operations with fully unattended train operations including setting a train in motion, driving and stopping the train, opening and closing the doors, remote train control and recovery operations in the event of disruptions.

FA2 was implemented in 2025 via Flagship Project 2 – R2DATO (FP2-R2DATO) and FP2-MORANE-2.

FP2–R2DATO aims to develop and demonstrate technologies and operational solutions enabling more automated and autonomous railway operations. The project brings together technical enablers covering automation, ATO, perception, connectivity, train positioning, moving block, remote driving, and digital technologies, with the objective of validating their benefits and readiness for future deployment.

The **Automation Processes Cluster** (APC) has progressed on developing the technical enablers required to progress towards automated and autonomous train operation, covering Automating Functions, ATO GoA3/4, Perception, and Remote Driving. It delivered the first stable baseline specifications for the four Technical Enablers, supported by safety studies, enabling the development and testing of laboratory prototypes. Major advances were achieved across all four areas, with Automating Functions prototypes reaching TRL4, ATO prototypes approaching technical completeness, four Perception System prototypes validated in the laboratory, and Remote Driving prototypes progressing towards demonstrator integration. These results established readiness for the 2026 demonstration phase.





In the **Optimised Headway Cluster**, progress was made on developing and validating ERTMS game changer prototypes, including Hybrid Train Detection, Moving Block, Train Integrity and Length determination, optimised braking, and absolute train positioning. Significant advances were achieved in the RBC-Interlocking concept, HTD, Next Generation Brake System, and Train Integrity and Train Length functions, with specifications, safety analysis, use cases, and test environments progressing towards integration. ASTP activities advanced towards a generic architecture through eight demonstrators, supported by laboratory and field testing, a common KPI framework, and safety assessments. EGNOS-related work progressed with a rail deployment roadmap and initial dual-frequency, multi-constellation GNSS testing, supporting safe and harmonised train positioning.

The **Enabling Digital Technologies Cluster** advanced solutions for future-proof railway connectivity, on-board communications, modular IT platforms, and the Digital Register. Significant progress was achieved in defining on-board network management requirements, testing FRMCS gateways and end-to-end communications, and developing recommendations for the certification and homologation of Modular Computing Platforms. Digital Register demonstrators and a standardised trackside-to-on-board interface were developed with the System Pillar and ERA, while ACS/Gigabit Train connectivity solutions completed laboratory testing at TRL4/5. These results support interoperable connectivity, IT, and data platforms for automated rail operations.

FLAGSHIP AREA 2

Digital & Automated up to Autonomous Train Operations

The **Fast and Efficient Deployment Cluster** focused on accelerating the development, migration, validation, and deployment of future DATO solutions by addressing architectural evolution, human and operational factors, and certification. The workstream developed architecture alternatives, a rail-specific DevOps framework, and demonstrators supporting evolvable on-board systems, while Formal Methods activities advanced TCMS data services, interoperability testing, and formal modelling. DATO assessment and migration work quantified infrastructure wear and cost reduction potential and refined migration methodologies and the business case value framework. In parallel, virtual certification strategies, test-bench analysis tools, simulation platforms, and subsystem Digital Twins were developed, establishing the foundations for efficient future validation and model-based certification.

The **Innovative Operational Solutions Cluster** advanced concepts beyond GoA4, focusing on Autonomous Route Setting (AnRS), Virtually Coupled Train Sets (VCTS), and Self-Driving Freight Wagons (SDFW), supported by Short-Range Communications and Relative Localisation technologies. AnRS use cases and trackside concepts were completed, with a dedicated simulation environment developed for early validation. The VCTS operational concept and system architecture were consolidated, supported by risk and cybersecurity assessments and initial simulation scenarios. For SDFW, use cases and five operational types were defined, alongside business case analysis covering CAPEX and OPEX. SRC and RL technologies were implemented and tested in laboratory and field trials, including a three-day campaign with two NS SNG trains, providing initial validation for VCTS and SDFW applications.



All demonstrators foreseen in FP2-R2DATO progressed significantly in 2025 towards validation of the technical enablers and their target applications.

All **demonstrators** foreseen in FP2-R2DATO progressed significantly in 2025 towards validation of the technical enablers and their target applications. The Regional, Urban, and Main Line demonstrators advanced the integration and laboratory testing of automatic functions, ATO, perception, remote driving, and other technical enablers, with field and operational testing planned for 2026. The ETCS HTD Deployment Strategies Demonstrator completed capacity simulations and developed deployment and migration strategies across several European countries. The Moving Block System Demonstrator was successfully tested on a Deutsche Bahn test track in Germany, validating dynamic train spacing and integration with the Digital Register and Plan Execution module. The Stabling and Shunting Demonstrator validated remote control, GoA4 automation, and obstacle detection in real-world mixed-traffic conditions in the Netherlands, while the Onboard Platform Demonstrator completed implementation and testing of multiple user stories covering connectivity, FRMCS, modular platforms, and on-board communication networks.

FP2-MORANE-2 aims to validate the FRMCS V2 specifications and contribute to the definition of V3 requirements through testing pre-commercial FRMCS components in realistic operational conditions. The project focuses on developing a future-proof FRMCS architecture, testing key V2 functions, and feeding operational experience back into the UIC FRMCS Programme ahead of the first FRMCS specification in the CCS TSI.

In 2025, the project focused on defining laboratory and field test scopes, developing test cases and strategies, and progressing the End-to-End Generic



Architecture. Laboratory preparations were initiated, with testing planned from mid-2026 followed by field demonstrations from early 2027 across five testbeds in Sweden, Germany, the Netherlands, and Spain. A Liaison Committee with ERA was also established to ensure effective coordination and integration of MORANE-2 results into future FRMCS specifications.

FLAGSHIP AREA 3

Intelligent & Integrated Asset Management

The main objective of FA3 is to provide new innovative technical requirements, methods, solutions and services (including technical requirements and standards for future developments) based on the latest leading-edge technologies to minimise asset life-cycle costs or extend life cycles, while meeting the safety and improving the reliability and availability and capacity of the railway system, addressing both infrastructure and rolling stock.

In 2025, FA3 was implemented via Flagship Project 3 – IAM4RAIL (FP3-IAM4RAIL) launched in December 2022.

FP3–IAM4RAIL aims to develop intelligent asset management solutions for a more efficient, resilient, and sustainable European railway system. The project focuses on combining advanced digital technologies, data-driven approaches, and predictive maintenance to improve the monitoring, management, and lifecycle performance of railway infrastructure and assets.

In 2025, Sub-Area 1 on **Wayside Monitoring and TMS Link** started testing and validation of the Intelligent Asset Management System in Italy and Spain, reaching TRL6. Work focused on integrating wayside asset data with TMS and maintenance systems, developing anomaly detection and fault prediction models, and creating dashboards for asset monitoring and decision support. Interfaces between IAMS and TMS were defined to support operational responses to asset failures, including rerouting and priority management. Initial results indicate potential improvements of up to 50% in asset availability and reliability, alongside reductions in maintenance costs and in-service failures.

Sub-Area 2 on **Rolling Stock Asset Management** consolidated an integrated approach to on-board and wayside monitoring, supporting data-driven maintenance and operational decisions. Work advanced monitoring of sanitary systems, HVAC and magnetic track brakes, enabling early anomaly detection and more targeted maintenance. The European Railway Checkpoints concept was validated as an operational model, integrating acoustic and vibration sensing, imaging, video analysis, laser scanning and RFID for multi-modal inspection of rolling stock and



Infrastructure Asset Management progressed from technology development to large-scale demonstration, with solutions reaching TRL6–8 across Europe.

infrastructure. Several configurations were deployed and tested, with demonstrators reaching TRL5–6 and showing potential to reduce service failures (up to 30%), improve traffic fluidity and reduce service disruptions, particularly in mixed-traffic environments where rolling stock diversity increases diagnostic complexity.

Sub-Area 3 on **Infrastructure Asset Management** progressed from technology development to large-scale demonstration, with solutions reaching TRL6–8 across Europe. Work focused on long-term maintenance optimisation, advanced sensing, multi-source data integration, and civil asset monitoring. Digital Twins, predictive maintenance tools, and advanced monitoring systems improved asset life-cycle assessment, reducing corrective interventions by up to 25% and increasing track availability by 10%. New sensing and data-driven solutions for track, switches, ballast, bridges, tunnels, and geological risks were validated, with tangible benefits, e.g. bridge inspection times reduced by up to 50%.



Sub-Area 4 on **Railway Digital Twins** advanced the integration of real-time data, simulation, and certification to support railway asset management and operations. The BIM-based Digital Twin of Málaga Zambrano station reached TRL6, integrating environmental, passenger flow, CCTV, IoT, SCADA, and maintenance data, improving operational responsiveness by 20% and reducing manual inspections by 15%. Digital waste management was deployed at three stations, reducing cleaning costs by 25% and response times by 30%. A Virtual Certification Framework and standardised Common Data Environment were also developed, improving traceability, data exchange, and certification efficiency across railway assets.

Sub-Area 5 on **Environment, User and Worker Friendly Railway Assets** advanced solutions for more sustainable, accessible, safe, and ergonomic railway assets. The green turnout demonstrator was installed in Austria, reducing CO_2 emissions by 15%, while Additive Manufacturing achieved significant reductions in production time and costs, including an in-situ L-DED rail repair. Robotic inspection and intervention platforms progressed, with three demonstrators reaching TRL6. Wearable technologies also advanced, with an exoskeleton entering integration and Augmented Reality systems validated for track monitoring, supporting safer and more efficient maintenance and training.

FLAGSHIP AREA 4

A Sustainable & Green Rail System

The main objective of FA4 is to provide new innovative products and services based on leading edge technologies to minimise the overall energy consumption and environmental impact of the railway system, to make this transportation mode healthier and more attractive and to provide resiliency against climate change at a reduced total cost of ownership.

FA4 was in 2025 implemented via Flagship Project 4 – RAIL4EARTH (FP4-RAIL4EARTH) launched in December 2022.

FP4–RAIL4EARTH aims to make the European railway system more sustainable, energy-efficient, resilient, and environmentally friendly. The project focuses on reducing the environmental footprint of rail infrastructure and operations through innovations in energy efficiency, circularity, sustainable assets, climate resilience, and improved environmental performance.

In 2025, Sub-Area 1 on **Alternative Energy Solutions for Rolling Stock** advanced battery-electric and hydrogen propulsion technologies to reduce reliance on diesel. Laboratory testing of traction components for BEMU demonstrators progressed, including batteries, converters, transformers, and SiC-based power electronics, while studies assessed suitable routes for long-range operation. Energy management strategies and predictive consumption models were developed to improve efficiency and extend battery range, alongside research into thermal energy reuse. Hydrogen storage development was also completed, with the integration and optimisation of a metal-hydride reactor for a hybrid locomotive demonstrator.



Sub-Area 2 on **Energy in Rail Infrastructure and Stations** focused on finding solutions for hydrogen refuelling energy storage, renewable energy integration, and energy-efficient stations. Hydrogen refuelling station optimisation was validated through Polish case studies, alongside hazard analysis and the initial design of an interoperable refuelling demonstrator. The Urban Energy Hub in Rotterdam demonstrated in operation viable alternative to sub-station at significantly lower cost (30% of the cost of a conventional station). Work also progressed on AC railway energy storage, modular low-emission stations, and the Railway Station Energy Digital Twin for Málaga-María Zambrano station.

The Urban Energy Hub in Rotterdam demonstrated in operation viable alternative to sub-station at significantly lower cost (30% of the cost of a conventional station).

In Sub-Area 3 on **Sustainability and Resilience of the Rail System**, work centred on improving rail sustainability and resilience through adaptation to climate change, energy optimisation, and mitigation of noise and vibration impacts. Pre-standardisation activities established a common mechanical interface and key parameters for railway hydrogen refuelling, while energy management studies addressed efficient BEMU charging and train preconditioning. Climate risk assessment progressed with four impact chains and 31 railway assets mapped against key hazards. Research on aeroacoustics, vibration monitoring, ground-borne noise, and curve squeal also advanced, alongside recycled-material solutions and initial ecolabel and circular economy marketplace concepts.

In Sub-Area 4 on **Electro-mechanical components and sub-systems for the rolling stock**, integration and safety studies for the airless brake progressed, while two airless pantograph prototypes moved towards testing and pre-standardisation. Three airless suspension concepts were assessed, indicating potential weight, energy, noise, and life-cycle cost reductions. A Digital Twin and test procedures were developed for an eco-friendly HVAC system, while motor and gearbox optimisation activities are positively progressing toward a targeted 20% weight reduction. Aerodynamic research also progressed through wind tunnel testing and numerical simulations, alongside completion of the lightweight freight wheelset demonstrator.

As Sub-Area 5 focuses on having a **Healthier and Safer Rail System**, work focused on reducing health risks for passengers and staff and improving the understanding and assessment of non-exhaust emissions from railway operations. Initial on-board demonstrations included validation of a PEPA-F™ pathogen filter on a DB train, particulate filtration tests, and HVAC-related solutions, while hat rack and headrest concepts continued testing in Germany. Air quality monitoring at Stockholm's Arlanda Central Station provided data for machine-learning models, identifying train frequency and time of day as key predictors and supporting the assessment of pollutant reduction measures. In parallel, work towards a pre-standardised methodology for calculating rail-related PM10 and PM2.5 emissions identified braking, wheel-rail and pantograph-overhead contact as key sources and compared three approaches for emission quantification.

Finally, significant progress was also achieved in Sub-Area 6 on **Trains Attractiveness (Interiors)**, making train interiors more modular, adaptable, sustainable and comfortable while supporting increased passenger capacity. Quick-fixing systems for interior modules, including luggage racks, bike racks and cantilever seats, were developed and validated through proof-of-concept testing, with seat designs supporting both improved comfort and higher capacity. Two immersive 3D virtual reality configurators were developed to support train layout design and refurbishment planning, with one fully operational and the second validated at TRL 5. Circular economy activities progressed through the assessment of recycled materials and the development of a sustainable wood-based bio composite roof panel, while work on modular ceiling structures, cable-free electrical solutions and acoustic optimisation further supported flexible and passenger-oriented interior designs.

FLAGSHIP AREA 5

Sustainable Competitive Digital Green Rail Freight Services

The objective of FA5 is to make rail freight more attractive through increased capacity by leveraging innovations such as Digital Automatic Coupling (DAC). DAC enables more functionalities in freight, and together with seamless interaction of the various IT systems, leads to increasing network capacity smartly for all types of rail freight transport.

This also results in significantly improved cross-border operations and multimodal customer services. Increased capacity is crucial for enabling a shift of transport volumes to rail, thereby substantially reducing greenhouse gas emissions.

In 2025, FA5 was implemented via Flagship Project 5 – TRANS4M-R (FP5-TRANS4M-R, launched in July 2022) and Flagship Project 5 – DACtiVate (FP5-DACtiVate, launched in December 2024).

FP5–TRANS4M-R aims to transform European rail freight into a more competitive, digital and sustainable logistics backbone. The project develops and demonstrates fully digital freight train operations and seamless freight services, with Digital Automatic Coupling (DAC), automation, digital rail services and interoperable solutions supporting higher capacity, faster operations and improved cross-border coordination. It works through two interlinked clusters.



In 2025, work under Workstream 1 on **Full Digital Freight Train Operations** with DAC progressed from requirements and architecture towards testing and large-scale validation of Full Digital Freight Train Operations (FDFTO), with Digital Automatic Coupling (DAC) as a key enabler. Two demonstrator trains equipped with DAC are already operating commercially in Sweden, while further demonstrators in Austria and Italy are being prepared, including locomotives and around 200 wagons equipped with DAC and FDFT technologies.

Interoperable power and data supply reached TRL 6, while DAC Level 4 functionalities were validated in the Berlin Train Test Lab. Safety, cybersecurity and operational requirements were consolidated, and automated yard operations progressed through retrofitted shunting equipment. Harmonised architectures and requirements continued to support interoperability, testing and integration with the System Pillar and FP2.

Railway Checkpoints reached TRL 8, with intelligent video gates and wayside systems operating across Germany, the Netherlands, Spain and Sweden.

Work under **Workstream 2** on **Seamless Freight** focused on improving the efficiency and interoperability of freight data flows, enabling seamless planning, execution and management across borders, actors and transport modes. The Seamless Corridor showcase progressed through integrated requirements, use cases and cross-FA developments along the Malmö–Alnabru corridor, while alignment on data models, semantics and interfaces strengthened interoperability with FP1-MOTIONAL and FA3. Data sharing with RNE was established, enabling historical train-run data to support ETA prediction models, while preparations continue for live-data testing. Railway Checkpoints reached TRL 8, with intelligent video gates and wayside systems operating across Germany, the Netherlands, Spain and Sweden. Advanced planning, dynamic dispatching and intermodal monitoring capabilities were also further integrated to improve real-time freight coordination and reliability.

By integrating these two clusters, FP5-TRANS4M-R is well-positioned to enhance the attractiveness of rail freight through increased capacity, operational efficiency, and environmental sustainability. The 2025 focus on demonstrator execution, interoperable train-borne functions, and seamless information flows shows a clear transition from analysis and specification to integrated validation and corridor-level showcases, advancing Europe's vision for a modern, efficient, and connected rail freight system.

FP5–DACtiVate aims to enable the pre-deployment of pilot trains with Digital Automatic Coupling (DAC) by executing required additional tests to the complementary project FP5-TRANS4M-R, thus establishing confidence before full implementation, while enabling DAC-authorisation processes. The project aims to test the interchangeability of DAC components, expand the number of Wagon Onboard Units in line with FP5-TRANS4M-R's system architecture, and enable thorough validation of the pre-deployment trains by additional locomotives able to integrate hybrid couplers. Collaboration with FP5-TRANS4M-R is vital to align with its functional specifications and technical architecture, ensuring the project's contribution is significant and supports the related DAC authorisation process.

Since the start of project FP5-DACtiVate, tests for derailment and in the climate chamber could be carried out, providing awareness of the state of technical development of the DAC components. Next steps for testing will address crash tests, interoperability, interchangeability and hybrid coupler tests with two Loco types.

FLAGSHIP AREA 6

Regional Rail Services/ Innovative Rail Services to Revitalise Capillary Lines

Flagship Area 6 (FA6) is dedicated to ensuring the long-term sustainability of regional railways by significantly reducing the Total Cost of Ownership (TCO), encompassing both operational and capital expenditures, while simultaneously enhancing service quality and operational safety.

The initiative aims to make rail transport a more attractive and preferred option by leveraging digitalisation, automation, and emerging technologies across signalling, trackside components, rolling stock, and customer information systems.

In the first phase of the programme, FA6 is implemented via the project FP6-FutuRe that started in December 2022.

FP6–FutuRe aims to revitalise regional and capillary railway lines by reducing total cost of ownership while improving service quality, operational reliability and passenger attractiveness. The project develops cost-efficient solutions for signalling, infrastructure, rolling stock, communications and customer services, combining digitalisation, automation, alternative propulsion and multimodal connectivity to support sustainable and economically viable regional rail services across Europe.

In 2025, Sub-Area 1 on **Regional Rail System Solutions/ Architecture** made great strides in consolidating a harmonised system architecture and requirements for regional rail, in close coordination with the System Pillar and FP2-R2DATO. Architectural requirements covering train-to-track and trackside-to-trackside communications and wayside assets were refined, while operational and functional requirements for regional lines continued to be consolidated and compared with current TSIs. KPI measurement approaches were established for the demonstrators, and safety and security analyses identified key risks and mitigation measures for the technical work packages. A two-level migration strategy was also developed, covering both the market deployment of common technical enablers and the transition from laboratory to country-specific field testing.

With regards to Sub-Area 2 on **Regional Rail Command, Control and Signalling CCS & Operations**, work progressed on cost-efficient CCS and operational solutions tailored to regional lines, with demonstrations covering ATO, Remote Driving, Hybrid Train Detection, Moving Block, Traffic Management Systems and Advanced Safe Train Positioning. ATO GoA2 demonstrations tested interoperability and adhesion management, while remote driving trials explored its role as an intermediate, backup and unmanned-operation solution. Laboratory preparation advanced for GoA3/4, Moving Block and HTD, including integration of FP2-R2DATO prototypes. ASTP demonstrators progressed through test preparation and on-site equipment installation, with field campaigns underway, while laboratory integration of Train Integrity and Length determination prepared the next phase of testing.

As part of Sub-Area 3 on **Regional Rail Infrastructure Assets**, the development of cost-efficient infrastructure assets centred on simplifying systems, reducing cabling and enabling wireless power and data transmission.

The first solar-powered wireless trackside gate signal demonstrated functional communication with level-crossing equipment, while obstacle detection tests generated initial performance results.



Ten demonstrators and one simulation were developed across wireless self-sufficient wayside assets, obstacle detection, wireless communication and multi-connectivity solutions. Key activities included defining use and test cases, establishing demonstrator architectures, and developing prototypes and test environments. The first solar-powered wireless trackside gate signal demonstrated functional communication with level-crossing equipment, while obstacle detection tests generated initial performance results. Multi-bearer gateways and cloud-enabled communication architectures were also developed to support flexible, reliable and cost-effective regional rail operations.

Sub-Area 4 on **Regional Rail Rolling Stock** addressed lightweight, modular and emission-free vehicles for G1 and G2 regional lines. Car body studies assessed topology-optimised steel and composite structures to reduce mass and costs, while two single-axle running gear concepts were further specified, with the conventional design confirmed against required standards. Battery sizing and charging station locations were optimised across different routes to balance range, cost, weight and environmental impact. Preparations for G2 demonstrators also advanced, including integrated RBC/Interlocking, satellite positioning and train-to-cloud communication, with hardware specifications and software integration initiated for the selected Swedish test line.

Sub-Area 5 on **Regional Rail Customer Services** worked on passenger-focused services centred on multimodal information, demand-responsive transport (DRT) and congestion management, with emphasis on interoperability between Passenger Information Systems (PIS) and Traffic Management Systems (TMS). A web-based PIS was implemented with timetable, real-time and DRT data, including journey planning and support for passengers with reduced mobility, while the PIS–TMS interface and demand data processing were established. Data collection and machine-learning models for passenger congestion prediction were initiated, and an optimisation algorithm for allocating trains to station platforms reached the testing phase, aiming to reduce passenger transfer times by considering walking distances, delays and passenger flows.

FLAGSHIP AREA 7

Innovation on New Approaches for Guided Transport Modes

Flagship Area 7 (FA7) focuses on exploring innovative, non-traditional, and high-speed guided transport systems. The goal is to integrate these new systems into existing rail networks to achieve socio-economic efficiency and sustainability across Europe. In 2025, the following projects contributed to this FA:



FA7 pods 4 RAIL

The **Pods4Rail** project aims to develop a concept for pods and pod carriers on railway to better adapt rail transport to user demand by providing higher flexibility and efficiency as well as offering on demand transport.

In 2025, the project moved from high-level concepts towards more detailed system and design development. Design concepts for different use cases were elaborated, covering materials, joining technologies, design features and alternative configurations, followed by the development of a detailed concept for a sample transport vessel.

Further work addressed the equipment of the sample vessel, including power supply, packaging, passenger HVAC, localisation and communication systems. The concept for pod traffic coordination was also initiated, covering system requirements, information and communication architecture, and traffic management. In parallel, technology options for the pod coupling system were assessed and a dedicated concept was developed to support interoperability between transport modes.

The **Hyper4Rail** project aims to define the role of Hyperloop within Europe's future multimodal transport system by developing a harmonised European concept, system requirements and a Concept of Operations, while assessing the technical, economic and safety aspects of deployment.

In its first year, the project established a technical and strategic foundation by reviewing existing Hyperloop concepts, technologies, stakeholder needs and European transport policy objectives. Preliminary stakeholder analysis highlighted the potential for Hyperloop on long-distance corridors, particularly as a complement to rail and an alternative to aviation, with speed, connectivity and interoperability identified as key priorities.

A quantitative cost-benefit analysis was developed for a European Hyperloop network, indicating significant potential for shifting intra-European aviation demand and identifying the economic conditions for viability. A preliminary Concept of Operations and common system architecture were also established, together with safety targets and risk acceptance criteria inspired by European railway and aviation frameworks. Initial system requirements and technology assessments covered vehicle design, aerodynamics, tube loads, levitation, propulsion, cooling and command, control and signalling, while a first business case was developed for a France–Italy corridor.

On 1 December 2025, the **MaDe4Rail 2** project (MAGLEV-DERIVED SYSTEMS FOR RAIL 2) was launched. Gathering 19 partners, the project aims to advance the development of Maglev-Derived Systems (MDS) and assess their feasibility for integration into the European railway network.

Building on the outcomes of the previous MaDe4Rail project, MaDe4Rail 2 will refine MDS configurations and investigate their compatibility with existing infrastructure, focusing on subsystems such as power, propulsion, levitation and guidance.

Exploratory Research

The **Academics4Rail** project aims to build a stable and durable community of railway scientific researchers and academia to share and exchange scientific knowledge with Europe's Rail, as well as to enable a network of PhDs (with academia teaming up with industry).

In 2025, the project established a Scientific Observatory based on a global survey of 296 responses, identifying research gaps and future PhD topics. An assessment framework linking innovation performance to impacts such as carbon reduction and passenger welfare was developed and validated through a UK case study. Six PhD programmes advanced research on freight aerodynamics, electromagnetic compatibility, additive manufacturing, virtual coupling communications, predictive maintenance and AI-based driving assistance, and strengthening academia–industry collaboration.

The **InBridge4EU** project addresses unresolved issues in current railway infrastructure standards, focusing on improving the dynamic interface between railway bridges and rolling stock.

In 2025, the project finalised a rolling stock database and identified key vehicle parameters influencing bridge response, supporting updated Dynamic Train Categories. More than 500 simplified bridge models were analysed, while coupled simulations assessed track irregularities and moving loads. Research on structural damping proposed revisions to EN 1991-2, and studies highlighted the importance of track quality, high-frequency vibrations and lateral stability. Results provide an evidence base for future bridge–train compatibility requirements and Eurocode and TSI updates.

The **RAIL4CITIES** project aims to transform railway stations into promoters of sustainable cities. It focuses on developing a new operational model and deploying it across five European living labs, each targeting different aspects of station transformation.

Completed in June 2025, the project developed the Sustainable City Promoter (SCP) model, combining seven Fields of Action with a Methodological Toolkit. The approach was tested through five Living Labs in France, Italy, Germany, Poland and Belgium, addressing green mobility, energy, Transit-Oriented Development, Nature-Based Solutions and the 15-minute city. Three additional case studies examined resilience along the Lisbon–Porto rail line. The results provide a transferable, human-centred methodology for integrating stations into sustainable and inclusive urban development.



LEADER
Learnings for European Autonomy to Deliver Europe's Rail in 2030

LEADER 2030 aims to address the future availability of raw materials and components for EU-Rail innovations by 2030.

In 2025, the project analysed the Europe's Rail Master Plan and Multi-Annual Work Programme, mapping required hardware, software, components and raw materials and identifying potential obsolescence. A supply-side assessment examined availability, market dynamics, sourcing dependencies, geopolitical risks, recycling and substitution potential, supported by material factsheets. Visits to aluminium, copper and semiconductor facilities in Belgium, Italy and Germany provided further insight into strategic supply challenges.

DACcord

As a support action, **DACcord** coordinated efforts related to the European DAC Delivery Programme (EDDP).

In 2025, DACcord strengthened coordination between rail freight and industry stakeholders through the Joint Sector activity and reinforced programme management through Sounding Board meetings, risk workshops and coordination with FP5-TRANS4M-R, DACFIT and FP5-DACtiVate. The DAC migration roadmap was further developed using updated fleet data, migration scenarios and work on locomotive re-authorisation and mixed coupler systems. Stakeholder engagement expanded through nine DAC Fora and participation in more than 20 public events and industry workshops.



ESEP 4 Freight

The **ESEP4Freight** project aimed to support the modal shift from road to rail by providing freight customers with accessible, transparent and reliable information on rail and intermodal transport options, while addressing contractual and regulatory barriers.

Completed in August 2025, the project developed a **web-based platform** integrating an interactive rail freight infrastructure map, CO_2 calculator, route and schedule viewers, smart contracts, blockchain and a matchmaking tool for SMEs. The interactive map reached TRL 7 and the route viewer TRL 6. Recommendations for more harmonised contractual and legal frameworks were also developed. Testing with logistics stakeholders demonstrated the platform's potential to support more efficient, sustainable and digitally enabled freight transport.

EXPLORATORY RESEARCH

SYMBIOSIS

The **SYMBIOSIS** project brings together experts from different fields to focus on biodiversity. It aligns with the United Nations' vision for responsible land use and supports the European Green Deal. The project aims to create a community where people working in transport infrastructure, energy, and biodiversity can collaborate.

In 2025, analysis of 102 environmental impact assessments identified inconsistencies in biodiversity assessment methodologies, data and life-cycle approaches. An international survey covering more than 15 countries highlighted fragmented monitoring practices, terminology and taxonomic coverage, while future work will assess AI and data-science opportunities. Stakeholder research emphasised the importance of early, inclusive engagement. Discussions with ISO/TC 331 explored biodiversity standardisation, and an interim strategy for the Knowledge Transfer and Learning Hub was completed.

QuieterRail

The main goal of **QuieterRail** project is to introduce a step change in predicting and mapping railway noise and vibration, acceptance testing of rolling stock and promoting cost-effective noise mitigation.

In 2025, prediction models for rolling noise, curve squeal and flange noise were developed and benchmarked, alongside improved methods for transferring measurements between sites. An optimisation tool was developed to balance life-cycle costs with noise and vibration performance, supported by a mitigation database. The SILVARSTAR ground-borne vibration methodology was further developed and validated against numerical models. Extensive measurements were completed on the Lyon tramway network, with mainline testing in Switzerland prepared.

DACFIT

The main objective of **DACFIT** is to provide a detailed and quantitative analysis of vehicle data, including a thorough assessment of retrofitting processes. It also evaluates the capacity and infrastructure of European workshops to support retrofitting, with the aim of developing a comprehensive and integrated retrofitting strategy and plan.

In 2025, DACFIT consolidated European vehicle data and developed a methodology to assess retrofit capability for locomotives, freight wagons and special vehicles. Standardised retrofit processes and a Europe-wide workshop database were established to map capacity requirements. The Decision Support System (DSS) architecture and specifications were finalised and initially tested, providing the basis for the comprehensive DAC retrofit and capacity plan planned for 2026.

NEXUS

The main objectives of **NEXUS** are to establish an innovation benchmark and provide guidance towards a transformative future for European metros, with a focus on optimisation and adaptability to passenger demands.

In 2025, NEXUS consolidated functional, operational and inclusivity requirements through engagement with passengers, operators, manufacturers and authorities. An integrated simulation environment covering passenger flows, vehicle dynamics, station operations and network adaptability was developed and validated at TRL 4. Future train control system architecture and specifications were defined, while four TRL 4 AI demonstrators addressed predictive maintenance, crowding, passenger demand and anomaly detection. Continued stakeholder engagement ensured alignment with operational and societal needs.

XCROSS

The main goal of the **XCROSS** project is to enhance the monitoring and inspection of railway crossing surface profiles.

In 2025, a lightweight 3D scanning prototype was developed and successfully tested on railway frogs. Initial Digital Twin models supported reprofiling strategy assessment, while an AR prototype was developed to visualise wear patterns. First 3D-printed templates supported on-site welding activities, and sensor testing and hardware/software integration progressed towards further system validation.

PhDs EU-Rail

The **PhDs EU-Rail** project aims to foster collaboration and innovation in the European railway sector by consolidating a scientific community and conducting research through 10 PhD positions. The project aligns with the goals of the EU-Rail Joint Undertaking (EU-Rail) and industry partners.

In 2025, all ten research topics progressed. Key results included a toolkit for rail decarbonisation pathways, gender-gap analysis and good-practice work, industry–academia education tools, and research on urban logistics and fast night trains. Bridge–train dynamics research supported future Eurocode revisions, while safety communication research developed digital prototypes for safety-critical contexts.

Further work delivered a social cost–benefit model for rail innovation, inclusive accessibility training approaches for people with intellectual disabilities, and a prototype ICT platform for reliable and interoperable ERTMS. These activities strengthened links between academic research and practical railway challenges and provided evidence and tools for future rail innovation.



TRANSVERSAL TOPIC (TT)

Digital Enablers

The goal of Digital Enablers is to introduce new digital capabilities across EU-Rail Work Programme destinations to support railway industry operations through the following solutions, delivered under the FP1-MOTIONAL project:

- **A Federated Rail Data Space Sandpit to enable cyber secure rail data exchange.**

  In 2025, the Federated Rail Data Space expanded Sandbox participation, including external participants, implemented extended data exchange methods, and completed development of a user-driven App Store. Planning also progressed for a Q2 2026 demonstration showcasing key Data Space functionalities. Industry engagement was supported through a public Town Hall presentation.

- **A Conceptual Data Model (CDM), as an extension of previous ERA and Shift2Rail's LinX4Rail project works on a standardised rail model and ontology.**

  In 2025, CDM and domain ontologies were expanded to cover localisation, ports, rolling stock and operations. Interoperability was strengthened through semantic bridges and standards including GeoSPARQL, ifcOwl and SOSA/SSN. Automated ontology quality assurance and JSON Schema generation were demonstrated. Reference datasets and RDF railway topology representations supported validation and reuse. Collaboration with FP1, FP3, FP5 and the System Pillar advanced use cases for maintenance, asset management and intelligent video applications, strengthening a scalable, standards-based semantic framework for rail digitalisation.

- **Solutions to support Digital Assets Engineering processes including the analysis of maintenance activities such as preventative maintenance and root cause fault detection.**

  Throughout 2025, data requirements were finalised and datasets acquired, enabling successful algorithm development. The Automatic Planning Tool reached approximately 70% completion for ETCS Level 2 without signals, with engineering rules implemented. Guidelines for BIM/AIM data acquisition and development were around 80% complete, while a proof-of-concept validation tool is planned for 2026.

- **A Digital Twin (DT) run-time environment and reusable, digital model units to enable the virtual representation of rail sub-systems supporting their validation and interoperability assessments.**

  In 2025, Digital Twin use cases were further developed towards TRL 5 validation, with three applications presented at the 2025 Modelica & FMI Conference. Generic use cases, component models and architectures were made available through a GitLab repository with supporting data and documentation. Initial distributed co-simulation tests using a web-service approach were also conducted, complementing existing on-premises simulation environments.



Deployment Group

The main objective of the High-Level Deployment Group (HL-DpG) is to analyse how to strengthen the capability of the sector to sustainably contribute and accelerate rail innovation to reach the market.

While implementation actions stay the responsibility of Railway Undertakings, Infrastructure Managers, Lessors and Member States, it focuses on different aspects to make recommendations to the different actors of the system on the deployment of innovative solutions that require high levels of coordination.

In 2025 the HL-DpG provided advice and recommendations to the sector and decision makers on the best way to deploy FRMCS (business driven: cost efficient, simple, fast), aligning to the following deliverables:

- analyse the current infrastructure, rolling stock, industry and workshop capacity for fast, easy and cost-effective deployment and estimate necessary capacities;
- support the acceleration and simplify authorisation;
- perform cost analysis, CBA and risk assessments;
- develop a toolbox with diverse migration scenario's (greenfield and brownfield situations);
- provide dedicated cross-border installation alignment analysis and public-private mobile network interface analysis;
- alignment with other major Rail programmes (ERTMS, DAC, etc.) and stakeholders.

In 2025, the High-Level Deployment Group focused on FRMCS deployment, holding three formal meetings and launching a sector-wide survey with 66 responses from 20 countries.

Key outputs of the group included analyses of technical deployment, national implementation, cross-border issues, financing, authorisation and migration scenarios.

A cost-driver model, deployment risk matrix and migration scenario toolbox were developed, alongside recommendations to simplify mass retrofitting.

The group also increased sector awareness through reports, webinars, conferences and newsletters.

A coordination and support topic for deployment activities was included in the EU-Rail Call 2025-02.

The main objective of the Deployment Group is to analyse how to strengthen the capability of the sector to sustainably contribute and accelerate rail innovation to reach the market.



The European DAC Delivery Programme

In July 2020, the Governing Board of the JU endorsed the creation of the European DAC Delivery Programme (EDDP) proposed by the ED, reflecting the request of the railway sector. Building upon the outcomes achieved in S2R's freight related R&I activities (IP 5), this Programme brings together the rail sector beyond the JU Membership to bridge the research work with innovation..

It includes migration planning towards the deployment of a European DAC solution, built on open and transparent standard specifications. This activity constitutes a major step forward for the digital rail freight, enabling new operations and services that will contribute to meeting the expectations of the Sustainable and Smart Mobility Strategy of the European Commission.

The EDDP, as an independently managed delivery programme, monitors and integrates the relevant results from the projects linked to Europe's Rail JU FA5 activities, such as FP5-TRANS4M-R, FP5-DACtiVate and DACFIT, on European rail freight.

In 2025, the DACcord Coordination and Support Action continued to support the running of EDDP. The refined EDDP programme planning as basis for an exhaustive risk management was delivered and the permanent coordination with FP5-TRANS4M-R Project via regular reports on the EDDP boards. Regular alignment meetings took place between the different bodies and, in coordination with the EU-Rail. This work is continued through executing and managing the DAC General Master Plan. It further worked on the DAC migration roadmap and on EDDP Stakeholder Management. The DACcord project also worked together with FP5 TRANS4M-R project for the continuation of the three so called EU-Rail "sounding boards". The results of these boards were reported to the EDDP programme board and used for evaluation by the FP5 TRANS4M-R Project.

In 2025 CINEA appointed the PioDAC consortium to lead and implement the Pioneer Train phase, the first commercial deployment of the new DAC system and equipment, building notably on the work of the EU-Rail FP5-TRANS4M-R project. As the timeline for operational use approached, the EDDP led several dedicated actions to address longstanding issues related to authorisation, technical topics and (pre-) production activities of DAC suppliers.

Considering the end of the support project DACcord, in 2025 first activities were taken to bring the EDDP activities under the umbrella of the High-Level Deployment Group.



Communication Activities

In 2025, the JU continued to promote the Europe's Rail Programme, focusing on increasing visibility of its R&I results, raising awareness of its mission and vision, promoting the calls for proposals, and highlighting the System and Innovation Pillars and the newly established High-Level Deployment Group. Communication activities centred on events, dissemination of Flagship and Exploratory Research results, stakeholder engagement and strengthening the Programme's European and international profile.

Europe's Rail reinforced engagement with European institutions and sector stakeholders. It participated in the European Commission's first Implementation Dialogue on High-Speed Rail, chaired by Commissioner Apostolos Tzitzikostas, focusing on efficient cross-border services and their contribution to decarbonisation, competitiveness and growth. It also engaged with the European Parliament's TRAN Committee on rail digitalisation and automation and participated in a joint Joint Undertaking event highlighting the contribution of public-private partnerships to EU priorities. Other activities included sponsoring the European Startup Prize and presenting its Special Prize on Rail Mobility, participating in the Cutting Costs in Rail conference under the Danish Presidency, and co-organising the Women in Rail Award with DG MOVE, ERA and sector associations.

The JU participated in **nearly 50 events** across Europe and beyond. At the ITF Summit, Europe's Rail hosted a media event highlighting R&I progress, international collaboration and its strategic vision, while welcoming ministerial delegations to its stand. At the UITP Summit 2025 in Hamburg, it hosted a Power Session and exhibition stand. Europe's Rail also organised a press event launching the Net-Zero Logistics Study, supported by a targeted social media campaign involving key European rail and logistics stakeholders. Internationally, participation in the World Congress of Railway Research in Colorado Springs highlighted EU-Rail's public-private partnership model, its contribution to addressing fragmentation, costs and resilience, and the role of system engineering in advancing the Single European Railway Area.

Promotion of the **2025 calls for proposals** remained a key priority. Call 2025-02 was promoted through an Information Day attended by more than **250 participants**, dedicated communications campaigns and a B2Match matchmaking platform with over **470 registered participants**. To further strengthen networking, collaboration and support regional participation, The Europe's Rail Brokerage Event was held at TRAKO in Gdańsk. Two meetings with Communication Officers from founding member companies, together with engagement with associated members and partners, further supported alignment on communication priorities and best practices.

Europe's Rail also strengthened project dissemination through updated **Communication and Dissemination Guidelines** that were revised and incorporated into the updated Governance and Process Handbook. It provided coordinated communications, 145 EU



50

events the JU participated in, across Europe and beyond.







Survey submissions, feature articles, events and digital channels. The General Assembly and dedicated Flagship Project sessions showcased achievements, encouraged knowledge sharing, strengthened stakeholder engagement and improved visibility and impact of EU-Rail research and innovation results.

Moreover, Europe's Rail expanded its communication tools by launching its podcast **The European Railcast**, with five episodes published in 2025.

The website was further improved, including new pages dedicated to the high-level paper and podcast, and regularly featured project results, demonstrator activities and corporate information.

The monthly newsletter was redesigned for improved readability, while new monthly project-update formats increased visibility of recent achievements. The team produced various publications including the AAR – Executive View, project closure factsheets and material supporting the future of the Programme.

Social media remained central to dissemination. By the end of 2025, Europe's Rail LinkedIn account had more than **16,600 followers**, while impressions exceeded **1.6 million**, compared with 1.2 million in 2024.

Continued cooperation with ERA, ERRAC, European and international organisations, EU bodies and associations, together with targeted engagement with journalists, contributed to broader media coverage and growing awareness of Europe's Rail and its contribution to European rail innovation, sustainability, competitiveness and resilience.

Other Activities

In 2025, Europe's Rail continued to make progress towards delivering its Programme, while strengthening its human resources, communication activities, internal organisation, control framework, audit arrangements and stakeholder engagement.

Human Resources and Administration

The **EU-Rail Staff Establishment Plan for 2025**, adopted by the Governing Board in November 2024, provided for **33 staff members**, including two Seconded National Experts and three staff members supporting Back Office Accounting arrangements covering accounting services for all Joint Undertakings. Following the revision of the Multi-Annual Framework and the reduction of the Horizon Europe contribution, together with the UK association agreement, one Contract Agent position was converted from EU-funded to third country-funded. This change did not affect the overall number of EU-Rail staff. An additional Temporary Agent position was financed through external revenues.



During 2025, the JU experienced **six staff departures**, with vacant positions progressively filled. To ensure continuity and address temporary staffing gaps or longer-term absences, EU-Rail made use of external competencies and expertise and temporarily outsourced certain administrative activities.

Internal Control, Risk Management and Audit

The JU continued improving its internal organisation to provide effective and continuous support to its members and beneficiaries. Particular attention was given to the implementation of the **internal control framework** and to the systematic assessment and management of risks.

The **EU-Rail Horizon Europe Control Strategy for grants** was updated in 2024 and again in 2025 to reflect the withdrawal of the DG RTD Common Audit Service from EU-Rail ex-post activities. As a result, EU-Rail assumed responsibility for conducting ex-post technical reviews. **Five reviews were launched in 2025**, while the two reviews launched in 2024 were completed with positive outcomes.

The JU also cooperated with key audit and oversight bodies, including the **European Court of Auditors, the Commission's Internal Audit Service, the DG RTD Common Audit Service and external auditors** responsible for the JU's annual accounts. In December 2025, the EU-Rail Anti-Fraud Strategy 2026–2028 was adopted, further strengthening the framework for protecting EU financial interests.

Throughout the year, EU-Rail systematically assessed control results and indicators, as well as observations and recommendations from the internal auditor and European Court of Auditors. These elements were considered in assessing management's assurance regarding the achievement of control objectives. Overall, management concluded that appropriate controls were in place and operating as intended, and that risks

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were being adequately monitored and mitigated. The Executive Director, acting as Authorising Officer by Delegation, signed the **Declaration of Assurance**.

Accountability and Follow-up

In 2025, the JU submitted a follow-up report to the **European Parliament** addressing observations from its resolution concerning the discharge procedure for the **2023 financial year**. The report described actions taken, or planned, in response to Parliament's observations.

It highlighted EU-Rail's role in transforming scientific knowledge into marketable innovations. In particular, the **Deployment Group** supports the uptake of innovations into the market and contributes to the creation of a Single European Railway Area. The **System Pillar** works closely with the European Commission on standardisation requests and with the European Union Agency for Railways on inputs to revisions of the Technical Specifications for Interoperability.

The report also provided an update on the implementation of the **Back Office Arrangements**, including EU-Rail's leading role in Accounting Services, and addressed HR-related observations by explaining the operational constraints faced by the JU and the actions taken to address them.

Overall, through the continued commitment of its Members and Programme Office, **2025 represented another year of progress towards delivering the EU-Rail Programme**, while maintaining sound governance, financial management, internal controls, risk management, stakeholder engagement and operational continuity.



Flagship Projects

Project name	Short description	Project value € M	Partners Involved	Duration
FP1-MOTIONAL	Network management planning and control & Mobility Management in a multimodal environment and Digital Enablers	92.6	90	46 months
FP2-R2DATO	Digital & Automated up to Autonomous Train Operations	160.8	77	42 months
FO3-IAM4RAIL	Intelligent & Integrated asset management	108.7	97	48 months
FP4-RAIL4EARTH	A sustainable and green rail system	95.1	73	48 months
FP5-TRANS4M-R	Sustainable Competitive Digital Green Rail Freight Services	103	78	54 months
FP6-FUTURE	Regional rail services/Innovative rail services to revitalise capillary lines	33.5	52	48 months
FP1-TRAVEL WISE	EU-Rail – SESAR synergy: integrated air and rail network backbone for a sustainable and energy-efficient multimodal transport system	6.8	37	36 months
FP2-MORANE-2	EU-Rail – SNS synergy: digital & automated testing and operational validation of the next EU-Rail communication system	19.1	43	34 months
FP5-DACtiVate	Digital Automatic Coupler – testing to support DAC authorisation, mix and match for DAC coupler head and draft gear interchangeability and DAC hybrid coupler fitting solutions	9.9	21	25 months

Other Projects

Project name	Short description	Project value € M	Partners Involved	Duration
Pods4Rail	Conceptual development of Automated Multi-Modal Mobility-Systems (Moving Infrastructures)	4.6	15	30 months
RAIL4CITIES	New Railway station concept for green and socially inclusive smart cities - **CLOSED**	0.9	11	24 months
InBridge4EU	Bridge Dynamics	1	12	36 months
ESEP4Freight	European Shift Enabler Portal for Freight - **CLOSED**	1.3	9	24 months
Academics4Rail	Building a community of railway scientific researchers and academia for ERJU and enabling a network of PhDs (academia teaming with industry)	1.9	25	42 months
LEADER 2030	European value chains for rail supply	0.7	4	30 months
DACcord	DAC migration roadmap towards deployment - **CLOSED**	1.5	6	36 months
MaDe4Rail	Maglev-Derived Systems for Rail - **CLOSED**	2.6	16	15 months
MaDe4Rail 2	Further Technological development of Maglev-derived Systems	4.6	19	36 months
QUIETERRAIL	Noise and vibrations	4.5	16	36 months
NEXUS	Future Metro Systems	3.6	13	24 months
SYMBIOSIS	Biodiversity	3	22	36 months
XCROSS	Disruptive Assets Management and solutions, including urban use cases	2.7	10	30 months
PHDS EU-RAIL	Extending the rail network of PHDs	2	15	36 months
DACFIT	DAC fleet retrofitting and retrofit capacity plan	1.9	8	24 months
HYPER4RAIL	Hyperloop – Roadmap towards industrialisation and harmonised implementable concept	2.6	27	24 months
tRail0.5	Studies on rail industry 5.0	0.6	3	30 months
VALORAIL	Studies on innovation in climate finance for rail	0.6	9	30 months
CLIFRAIL-EU	Studies on innovation in climate finance for rail	0.6	4	30 months

Europe's Rail Overview

Name	Europe's Rail Joint Undertaking (hereinafter "EU-Rail" or "JU").
Objectives [4]	EU-Rail is an autonomous body with its own legal personality. It is an institutional European partnership as per Article 187 of the Treaty on the Functioning of the European Union dedicated to managing and coordinating mission-oriented R&I activities for a major transformation in rail systems in Europe. The general objectives of EU-Rail are to: a. contribute towards the achievement of the Single European Railway Area; b. ensure a fast transition to more attractive, user-friendly, competitive, affordable, easy to maintain, efficient and sustainable European rail system, integrated into the wider mobility system; c. support the development of a strong and globally competitive European rail industry. The main focus of EU-Rail is on delivering a high-capacity integrated European railway network by eliminating barriers to interoperability and providing solutions for full integration, covering traffic management, vehicles, infrastructure and services, aiming to achieve faster uptake and deployment of projects and innovations.
Legal basis	Article 187 of the Treaty on the Functioning of the European Union [5] and Council Regulation (EU) 2021/2085 of 19 November 2021 establishing the Joint Undertakings under Horizon Europe and repealing Regulations (EC) No 219/2007, (EU) No 557/2014, (EU) No 558/2014, (EU) No 559/2014, (EU) No 560/2014, (EU) No 561/2014 and (EU) No 642/2014.
Executive Director (ED)	Mr Giorgio Travaini, appointed ED as of 22 May 2024. [6]

4 The key objectives pertaining to the S2R Programme, pursued by the former Shift2Rail Joint Undertaking, and inherited by its successor – EU-Rail, are the following:
- a 50 % reduction of the life-cycle cost of the railway transport system (i.e. costs of building, operating, maintaining and renewing infrastructure and rolling stock);
- a 100% increase in the capacity of the railway transport system;
- a 50% increase in the reliability and punctuality of rail services (measured as a 50% decrease in unreliability and late arrivals).

5 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A12016E187

6 Based on the EU-Rail GB Decision n° 07/2024

Governing Board

European Commission (EC) members:

• DG MOVE	Magda Kopczyńska
• DG RTD	Joanna Drake

EC alternates:

• DG MOVE	Kristian Schmidt
• DG MOVE	Joachim Luecking
• DG RTD	Jane Amilhat

Industry members:

• ACCIONA	Javier Bonilla
• ADIF	Luis Fernando López
• ALSTOM	Richard French
• ANGELRAIL CONSORTIUM LED BY MER MEC	Francesco Inzirillo
• AŽD	Vladimir Kampik
• CAF	Jorge De Castro
• CEIT	Juan Melendez
• ČD	Jan Ilík
• DEUTSCHE BAHN	Jasmin Bigdon
• DLR	Meike Jipp
• ESGR JV	Noemi Jiménez Redondo
• FAIVELEY TRANSPORT	Paolo Pagliero
• FERROVIE DELLO STATO ITALIANE	Andrea Volponi
• FREQUENTIS	Michael Holzbauer
• HITACHI RAIL STS	Antonella Trombetta
• INDRA-TALGO	Jose Miguel Rubio Sanchez
• INFRAESTRUTURAS DE PORTUGAL	Patricia Figueira
• JERNBANEDIREKTORATET	Preben Saethre
• KNORR-BREMSE	Hans-Christian Hilse
• KONTRON	Michael Mikulandra
• ÖBB	Mark Topal Goekceli
• PKP	Zbigniew Jancewicz
• PRORAIL-NS GROEP	Julien Cayet
• SIEMENS	Roland Edel
• SNCF	Christophe Cheron
• STRUKTON	Tjark de Vries
• THALES	Amaury Jourdan
• TRAFIKVERKET	Andres Carolin
• VOESTALPINE RAILWAY SYSTEMS	Franz Sodia
• XLAB	Nejc Bat

Governing Board	***Industry alternates:***	
	• ADIF	David-Ibán Villalmanzo Resusta
	• ALSTOM	Michael Haddad
	• ANGELRAIL CONSORTIUM LED BY MER MEC	Vincenzo Scarnera
	• AŽD	Michal Pavel
	• CAF	Imanol Iturrioz Villalba
	• CEIT	Jaizki Mendizabal
	• ČD	Petr Jindra
	• DEUTSCHE BAHN	Manuel Lianos
	• DLR	Michael Meyer zu Hörste
	• ESGR JV	José Solis Hernández
		Celestino Martínez
	• FAIVELEY TRANSPORT	Matteo Frea
	• FERROVIE DELLO STATO ITALIANE	Davide Pifferi
	• FREQUENTIS	Guenter Graf
	• HITACHI RAIL STS	Carlo Crovetto
	• INDRA-TALGO	Alfredo González Moreno
		Leyre Merle Carrera
	• INFRAESTRUTURAS DE PORTUGAL	Margarida Pinto
		Francisco Ganhão
	• JERNBANEDIREKTORATET	Pal Midtlien Danielsen
	• KNORR-BREMSE	Martin Ertl
	• KONTRON	Ulrich Geier
	• ÖBB	Flora Strohmeier
	• PKP	no alternate
	• PRORAIL-NS GROEP	Tijmen Voet
	• SIEMENS	Lars Deiterding
		Ralf Kaminsky
	• SNCF	Gilles Quesnel
	• STRUKTON	Henk Samson
	• THALES	Mounir El Said
	• TRAFIKVERKET	Christer Lofving
	• VOESTALPINE RAILWAY SYSTEMS	Uwe Ossberger
	• XLAB/SŽ	Jemenšek Blaž
	• XLAB/VIAS	Ismael Sanchez
		Manuel Menedéz Muñiz
	Other participants:	
	• EU-Rail	Giorgio Travaini, Executive Director
	Observers:	
	• ERA	Pio Guido (from January 2025)
		Oana Gherghinescu (replaced Pio Guido as from 2 June 2025)
		Anna Gigantino
		Ny Tiana Tournier
	• ERRAC	Marion Berbineau
		Artur Fojud
	• Scientific Committee (SC)	Angela Di Febbraro
	• State's Representative Group (SRG)	Miroslav Haltuf

Other bodies	• System Pillar Steering Group • High-Level Deployment Group (HL-DpG) • States Representatives Group (SRG) • Scientific Steering Group (SSG)
Staff number	31 posts as at year-end 2025 [7]
Total budget 2025	At year-end 2025, the JU implemented 100% of its commitment appropriations made available in its active budget (Titles 1 to 4) and 98.1% for the total budget (Titles 1 to 5). The payment appropriations were implemented up to 92.2% (87.9% in 2024) of the active funds (or 79.1% of implementation when compared to the full JU budget (including Title 5)). The Active budget relates to the Titles 1 to 4, while the Total budget includes the Title 5 of the Unused appropriations. By means of the GB Decision 17/2024 of 21 November, the EU-Rail Governing Board adopted the initial Annual Work Programme and Budget for 2025. There were two amendments to this initial Decision adopted during 2025 having impact on the budget. • ***Amendment number 1:*** The amendment recognised the increase of the commitment appropriations (Revenue and Expenditure) through the reactivation of unused appropriations from previous years with an amount of EUR 0.4 million for operational activities and EUR 0.1 million for administrative operations. At the same time, the expenditure appropriations were reallocated between titles, chapters and items in accordance with the revised needs of the JU for the year. • ***Amendment number 2:*** The amendment recognised the increase in commitment appropriations by EUR 3.3 million and in payment appropriations by EUR 3 million following the signature of new contribution agreements between Europe's Rail and DG MOVE. At the same time, the expenditure appropriations were reallocated between titles, chapters and items in accordance with the revised needs of the JU for the year. As a result, the budget as finally adopted amounted to: • **Commitment appropriations: EUR 151.5 million** • **Payment appropriations: EUR 85.8 million**

7 The full staffing as per the JU's Staff Establishment Plan comprises 32 posts, out of which 1 post was vacant at year-end 2025 and 29 working staff.

Budget implementation	The implementation rate of the active operational budget in commitment appropriations was 100% and 92.2% in payment appropriations (87.9% in 2024). **Commitment appropriations total consumption of the active budget: EUR 148.6 million is 100%, while the consumption percentage on the total budget is 98.1%.** Further breakdown by Titles in EUR and in % of total, excluding unused appropriations: Title 1 – EUR 3.8 million – 100% Title 2 – EUR 1.5 million – 100% Title 4 – EUR 143.2 million – 100% **Payment appropriations total consumption of the active budget: EUR 67.8 million representing 92.2% while the consumption percentage on the total budget is 79.1%.** Further breakdown by Titles in EUR and in % of total, excluding unused appropriations: Title 1 – EUR 3.6 million – 92.2% Title 2 – EUR 2.0 million – 92.8% Title 4 – EUR 62.2 million – 92.2% The reported implementation also includes payments to the Expert Evaluators managed by the REA Services.
Grants/ Tenders	The value of two signed grants in 2025 resulting from the 2024-01 and 2025-01 calls for proposals corresponds to EUR 8.9 million of funded by EU-Rail. In 2025, contracts/orders (legal commitments) amounting to EUR 12.4 million were signed, of which EUR 11.101 million resulted from operational procurements and EUR 1.28 million from administrative procurements.
Strategic Research & Innovation Agenda	In the context of EU-Rail, as defined in the SBA, the Strategic Research and Innovation Agenda (SRIA) represents the document covering the duration of Horizon Europe that identifies the key priorities and the essential technologies and innovations required to achieve the objectives of the JU. In accordance with SBA Article 86(5), the SRIA of EU-Rail is constituted by its Master Plan. [8]
Call implementation	• Number of calls launched in 2025: 2 • Number of proposals submitted: 1 (the second call closed in 2026) • Number of evaluated proposals: 1 • Number of proposals retained for funding: 1

8 https://rail-research.europa.eu/wp-content/uploads/2022/03/EURAIL_Master-Plan.pdf

Participation, including SMEs	Total number of beneficiaries, affiliated entities and associated partners in retained for funding in projects from the call 2025-01 only: 19, out of which: • 32% are SMEs receiving 46 of total EU funding provided by EU-Rail, 100% of the SMEs that participated to the call were retained for funding; • 63% are private for-profit companies receiving 71% of total EU funding provided by EU-Rail; • 5% are non-EU entities receiving 7% of total EU funding provided by EU-Rail; • 16% are newcomer entities. Six SME participations were part of the evaluated proposals in the 2025-01 call, all of which were included in the proposals retained for funding.

Members of the Europe's Rail Joint Undertaking[9]



9 As of the date of the adoption of the report in 2025



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