ADOPTED BY GB DECISION N° 04/2025 ON 24 JUNE 2025

EUROPE'S RAIL JOINT UNDERTAKING

Consolidated Annual Activity Report 2024

In accordance with Article 26 of Council Regulation (EU) No 2021/2085 of 19 November 2021 and with Article 23 of the EU-Rail Financial Rules.

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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FACTSHEET

Name	Europe's Rail Joint Undertaking – as of 30/11/2021 (hereinafter "EU-Rail")
Objectives[1]	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 task of EU-Rail is to deliver 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[2]. The founding legal Act of EU-Rail is the Council Regulation (EU) 2021/2085[3] of 19 November 2021, which entered into force on 30 November 2021, establishing the Joint Undertakings under Horizon Europe (hereafter the "Single Basic Act" or the "SBA"). By means of the SBA, the EU-Rail was established and became the legal and universal successor of the former S2R JU, which it replaced and succeeded as from that date. In addition, in its first meeting, the EU-Rail Governing Board approved the list of decisions adopted by the S2R JU that will continue to apply for EU-Rail in accordance with Article 174(12) of the SBA[4].
Executive Director (ED)	Mr Giorgio Travaini, appointed ED as from 22 May 2024[5].
Governing Board of EU-Rail	***European Commission (EC) members:*** • Magda Kopczynska, DG MOVE ***EC alternates:***

[1] 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).

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

[3] OJ L 427, 30.11.2021

[4] EU-Rail GB Decision n° 02/2021

[5] Based on the EU-Rail GB Decision n° 07/2024.

- DG MOVE Kristian Schmidt
- DG RTD Rosalinde Van Der Vlies

Industry members:

- ADIF Luis Fernando López
- ALSTOM Richard French
- ANGELRAIL consortium
- led by MER MEC Francesco InzirilloAŽD Vladimir Kampik
- CAF Jorge De Castro
- CEIT Juan Melendez
- ČD Jan Ilík
- DEUTSCHE BAHN Jasmin Bigdon
- DLR Michael Meyer zu Hörste
- eSGR JV Noemi Jimenez Redondo,
- Faiveley Transport Paolo Pagliero
- Ferrovie dello Stato Italiane Andrea Volponi
- HITACHI RAIL STS Antonella Trombetta
- INDRA-TALGO Jose Miguel Rubio Sanchez
- Jernbanedirektorate Preben Saethre
- KNORR-BREMSE Hans-Christian Hilse
- ÖBB Mark Topal Goekceli,
- PKP Jancewicz Zbigniew
- ProRail-NS Groep Julien Cayet
- SIEMENS Roland Edel
- SNCF Christophe Cheron
- Strukton Tjark de Vries
- THALES Amaury Jourdan
- TRAFIKVERKET Bo Olsson
- Voestalpine Railway Systems Franz Sodia

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	no alternate
	• eSGR JV	Jose Solis Hernandez Celestino Martinez
	• Faiveley Transport	Matteo Frea
	• Ferrovie dello Stato Italiane	Davide Pifferi
	• HITACHI RAIL STS	Carlo Crovetto
	• INDRA-TALGO	Alfredo Gonzalez Moreno Leyre Merle Carrera
	• Jernbanedirektorate	Pal Midtlien Danielsen
	• KNORR-BREMSE	Martin Ertl
	• ÖBB	Strohmeier Flora
	• 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 Dr Anders Carolin
	• Voestalpine Railway Systems	Uwe Ossberger

	Other participants: • Giorgio TRAVAINI, Executive Director of EU-Rail ***Observers:*** • Pio Guido (ERA) • Ana Gigantino (ERA) • Ny Tiana Tournier (ERA) • Dr Marion Berbineau (ERRAC) • Artur Fojud (ERRAC) • Angela Di Febbraro (SC) • Miroslav Haltuf (SRG)
Other bodies	System Pillar Steering Group Deployment Group States Representatives Group (SRG) Scientific Steering Group (SSG)
Number of staff	29 posts as at year-end 2024[6]
Total budget 2024	At the year-end 2024, the JU had implemented 99,9% of its commitment appropriations made available in its active budget (Titles 1 to 4) and 69,9% for the total budget (Titles 1 to 5). The payment appropriations were implemented up to 87,9% (85,2,% in 2023) of the active funds (or 64,3% 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 16/2023 of 5 December, the EU-Rail Governing Board adopted the initial Annual Work Programme and Budget for 2024. There were two amendments to this initial Decision adopted during 2024 having impact on the budget. - Amendment number 1: This amendment recognised and balanced (Revenue and Expenditure) unused appropriations of the S2R Programme operational expenditure due in relation to the previous budgetary years, in accordance with EU-Rail Financial Rules Article 6.5. EUR 32.9 million in payment appropriations were entered in the Budget for the last year of the S2R Programme execution in order to pay S2R Programme grants interim and final payments. - Amendment number 2: The Executive Director proposed to the Governing Board a 2nd amendment of the Budget in order to adapt both commitment and payment appropriations per line considering the

[6] The full staffing as per the JU's Staff Establishment Plan comprises 32 posts, out of which 3 posts were vacant at year-end 2024.

	evolution of budget needs, payment budget forecast expected until year-end, lower than planned, in particular for staff expenditure and associated costs (turnover in 2024), as well as to ensure the financing of the 2nd wave call of Flagship Projects under the WP 2025-2026 As a result, the budget as finally adopted amounted to: **Commitment appropriations: EUR 114,5 million** **Payment appropriations: EUR 120,8 million**
Budget implementation	The implementation rate of the active operational budget in commitment appropriations was 99,9% and 87,9% in payment appropriations (85,2% in 2023) In 2024, an important portion of payment appropriations was used for the second pre-financing of the grants resulting from the calls for proposals for 2023 and 2024. **Commitment appropriations total consumption of the active budget: EUR 80,1 million is 99,9%, while the consumption percentage on the total budget is 69,9%** Further breakdown by Titles in EUR and in % of total, excluding unused appropriations: Title 1 – EUR 3,3 million – 99,5% Title 2 – EUR 1,7 million – 99% Title 3 - 4 – EUR 75, million – 100% **Payment appropriations total consumption of the active budget: EUR 77,7 million is87,9% while the consumption percentage on the total budget is 64,3%** Further breakdown by Titles in EUR and in % of total, excluding unused appropriations: Title 1 – EUR 3,3 million – 88,6% Title 2 – EUR 1,8 million – 85,9% Title 3 - 4 – EUR 72,6 million – 87,9% The reported implementation also includes payments to the Expert Evaluators which is managed by the REA Services. In 2024, the third instalment of the grant agreements derived from the first call of 2022 and the award of 6 Flagship Projects have been covered with complementary budget (commitment appropriations). For the Shift2Rail Programme, the year 2024 mainly entailed ensuring the closure of the ongoing payments. By the end of 2021, the JU had signed 101 grant agreements in total since its autonomy in 2016. The R&I activities total valued including the accepted for payment in grants within the Programme has reached EUR 764,8 million (including Lighthouse Projects as part of the S2R initiative), of which EUR 628,7 million performed by the S2R Members with a funding made available by the JU to Members and non-Members up to of EUR 349,9 million. At the end of 2024, all of the 101 S2R projects and 32 operational contracts implementing part of the Programme were closed.

Grants/Tenders	The value of 9 signed grants in 2024 resulting from the 2023 and 2024 call for proposals corresponds to EUR 34,4 million of funded by EU-Rail In 2024, contracts/orders (legal commitments) amounting to EUR 13,5million were signed, of which EUR 11,09 million resulted from operational procurements and EUR 2,41 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[7].
Call implementation	Number of calls launched in 2024: 1 Number of proposals submitted: 3 Number of evaluated proposals: 3 Number of proposals retained for funding: 3
Participation, including SMEs	Total number of beneficiaries, affiliated entities and associated partners in retained for funding in projects from the call 2024-01 only: 891 • 14% of which are SMEs receiving 17% of total EU funding provided by EU-Rail, 100% of the SMEs that participated to the call were retained for funding. • 69% of which are private for-profit companies receiving 72% of total EU funding provided by EU-Rail. • 10% of which are non-EU entities receiving 2% of total EU funding provided by EU-Rail. 13 SME participations were part of the evaluated proposals in the 2024-01 call of which all of them were included in the proposals retained for funding.

FOREWORD

2024 was a year of transition towards a full EU-Rail Programme only type of activities and at the same time quite intense for the team due to temporary assignments related to the ad-interim transitions for the Head of Programme and Executive Director. Significant progress has been achieved as EU-Rail closed the S2R programme and widely disseminated its results, both with a new catalogue of solutions and with and coordinated participation at InnoTrans with the European Commission and the European union Agency for Railways. A highlight of the event was the Connected Tram Live Demo from Oslo, part of the Europe's Rail FP2 R2DATO project, which showcased the latest developments in tram connectivity and technology. This live remote tram operations demonstration, held in the presence of high-level participants, exemplified Europe's Rail's commitment to innovative rail solutions.

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

The EU-Rail R&I programme already engaged 361 participant entities from 27 countries by the end of 2024. EU-Rail Membership has been also set for further enlargement, with the Governing Board decision in June 2024 on launching a Call for Expression of Interest to select Associated Members. This was accompanied by an updated version of the Multi-Annual Work Programme that highlighted technical gaps requiring additional expertise.

In 2024, a reflection process involving all EU-Rail Members on the future of the JU was started and this activity will continue in 2025 providing insights to the European decision-makers. This included the GB approved EU-Rail phasing-out plan in November 2024, as well as the draft High-level Paper on future rail R&I within a policy-driven public-private partnership.

EU-Rail organised the successful side event "The Future of Rail Freight - see how it works in the 21st century!" during the Connecting Europe Days 2024, which featured live demonstrations of DAC technology at Train World in Brussels, under the Belgian Presidency of the Council of the European Union.

The first joint participation of EU-Rail with SESAR, Clean Hydrogen, and Clean Aviation JUs - demonstrating a united approach to innovation in European transport - happened at Transport Research Arena (TRA) 2024 in Dublin under the theme "Transport Transitions: Advancing Sustainable and Inclusive Mobility." Additionally, EU-Rail facilitated the first high-speed train service from Brussels to Berlin to InnoTrans 2024. This unique train brought together all rail stakeholders and their associations to sponsor the journey—demonstrating unprecedented unity—EU-Rail showcased R&I demonstration and standardised innovations at the European joint stand.

EU-Rail became the first Joint Undertaking to sign two Grant Agreements based on joint topic calls and synergy Memorandum of Understandings with SESAR JU for an optimised and harmonised exchange of traffic management information for passengers between rail and air, and with SNS JU for testing the next EU rail communication system. These joint activities allow rail to progress with other sector and highlight the strategic importance of those activities supported by the European Union.

The next EU rail communication system is a key enabler for further innovation that has been added to the EU-Rail Programme, building up on activities previously performed within different organisations, outside the EU governance. The sector and the Commission have entrusted EU-Rail to drive and to ensure as from 2024 the rail system ability in embracing this new solution, with R&I through the activities of its Innovation Pillar, with preparation for TSI updates with its System Pillar, and with migration planning and deployment recommendations with its Deployment Group. It is a cooperative work to be done with the European Union Institutions and Bodies for policy setting, including the EU Agency for Railways (ERA), with the rail sector and in particular working with the organisations having heavily invested in FRMCS[8], with the telecommunication sector, with the JU private Members contributing with additional in-kind activities, and with many other researchers contributing to the EU-Rail Programme under Horizon Europe.

EU has work and will continue to support the developing a comprehensive migration strategy to coordinate deployment of digital automatic couplings (DAC) technology, based on the R&I output of EU-Rail, which is highlighted as a game-changer for European rail freight in the 2023 Greening Freight Transport communication[9] of the EC to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions.

In the same package, the Commission also published a proposal for a Regulation on the use of railway infrastructure capacity in the Single European Railway Area[10], where the rail Infrastructure Managers are called on ensuring alignment, in particular regarding digitalisation of capacity and traffic management, with the work of the Europe's Rail Joint Undertaking as well as they shall contribute to the EU-Rail works in this regard.

The EU-Rail Research and Innovation activities are designed to deliver concrete solutions addressing the climate change crisis the world is facing, addressing climate mitigation and adaptation, but also the energy crises and new competitiveness challenges. The JU Programme Office and its Members are well aware of this urgency and the importance that the work of our integrated Programme has, covering innovative solutions' lifecycle, from exploratory research to pre-implementation and deployment.

[8] https://uic.org/rail-system/telecoms-signalling/frmcs

[9] https://transport.ec.europa.eu/system/files/2023-07/COM_2023_440.pdf

[10] https://transport.ec.europa.eu/system/files/2023-07/COM_2023_443_0.pdf

The launch of the Research and Innovation activities of the EU-Rail integrated Programme, building upon the results and advances of the S2R programmes, shapes the mission-oriented nature of the JU, building on openness and inclusiveness, answering the call of the Member States and Parliament to deliver impact and added value to European citizens. Synergies with other Union, as well as national and regional, programmes and partnerships shall provide opportunities to complement the series of actions expected from the rail sector, including interacting with ERRAC on complementary activities. Stakeholder relations, communication and dissemination of results ensure the visibility and uptake of the progress achieved. Sound financial and risk management and compliance will 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 dedicated to deliver this new ambitious integrated Programme.

The Executive Director would like to express all his gratitude to the EU-Rail Founding Members, the S2R Members, the EU-Rail staff, the Member States representatives and the observers for the collaboration and support during 2024 making those significant results possible.

INTRODUCTION

EU-Rail was established by 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 (hereinafter also the "Single Basic Act" or "SBA"), which entered into force on 30 November 2021. In accordance with Article 174(6) of the SBA, EU-Rail is the legal and universal successor in respect of all contracts, including employment contracts and grant agreements, liabilities and acquired property of the Shift2Rail Joint Undertaking which it replaced and succeeded.

EU-Rail is an autonomous body with its own legal personality having its seat located in Brussels, Belgium. It is an institutionalised European partnership as per Article 187 of the Treaty on the Functioning of the European Union dedicated to managing and coordinating mission-oriented Research and Innovation (R&I) activities for a major transformation in rail systems in Europe.

The Vision of EU-Rail is

To deliver, via an integrated system approach, a high capacity, flexible, multi-modal, sustainable and reliable integrated European railway network by eliminating barriers to interoperability and providing solutions for full integration, for European citizens and cargo.

The mission statement of EU-Rail is

"Rail Research and Innovation to make rail the everyday mobility"

In accordance with article 87(1) of the SBA, the members of EU-Rail are the Union, represented by the Commission, and 25 Private Members[11]. The Private Members of EU-Rail were selected via an open and transparent process, started with an "invitation to manifest the interest to become Candidate Founding Member of the Transforming Europe's Rail System European Partnership" on 13 August 2020 and concluded with the listing of 25 entities retained as Founding Members in Annex II of the SBA. The Private Members of EU-Rail signed a Letter of Commitment in accordance with the provisions of the SBA to deliver the contributions established in its Article 89.

The objective of Europe's Rail Joint Undertaking is to deliver 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. That should exploit the huge potential for digitalisation and automation to reduce rail's costs, increase its capacity and enhance its flexibility and reliability, and should be based upon a solid reference functional system architecture shared by the sector, in coordination with the European Union Agency for Railways (ERA).

[11] As per Article 2(5) of the SBA, "Private Member" means any legal entity established under public or private law that is a member of a joint undertaking other than the Union, participating states or international organisations.

In addition to the General and Specific Objectives common to all JUs established in Title II, Chapter 1 of the SBA, EU-RAIL is also entrusted with the following:

General Objectives

(d) contribute towards the achievement of the Single European Railway Area;

(e) 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;

(f) support the development of a strong and globally competitive European rail industry.

Specific objectives

(a) facilitate research and innovation activities to deliver an integrated European railway network by design, eliminating barriers to interoperability and providing solutions for full integration, covering traffic management, vehicles, infrastructure also including integration with non-standard national gauges, such as 1520, 1000 or 1668 mm railway, and services, and providing the best answer to the needs of passengers and businesses, accelerating uptake of innovative solutions to support the Single European Railway Area, while increasing capacity and reliability and decreasing costs of railway transport;

(b) deliver a sustainable and resilient rail system: by developing a zero-emission, silent rail system and climate resilient infrastructure, applying circular economy to the rail sector, piloting the use of innovative processes, technologies, designs and materials in the full life cycle of rail systems and developing other innovative solutions to guided surface transport;

(c) develop through its System Pillar a unified operational concept and a functional, safe and secure system architecture, with due consideration of cyber-security aspects, focused on the European railway network to which Directive 2016/797 applies, for integrated European rail traffic management, command, control and signalling systems, including automated train operation which shall ensure that research and innovation is targeted on commonly agreed and shared customer requirements and operational needs, and is open to evolution;

(d) facilitate research and innovation activities related to rail freight and intermodal transport services to deliver a competitive green rail freight fully integrated into the logistic value chain, with automation and digitalisation of freight rail at the core;

(e) develop demonstration projects in interested member states;

(f) contribute to the development of a strong and globally competitive European rail industry;

(g) enable, promote and exploit synergies with other Union policies, programmes, initiatives, instruments or funds in order to maximise its impact and added value.

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), in the case of EU-Rail, its Master Plan shall constitute the SRIA.

The EU-Rail's Master Plan builds also upon the "Rail Strategic Research and Innovation Agenda"[12] of the European Rail Research Advisory Council (ERRAC). ERRAC is a research platform composed of representatives from most of the major European railway research stakeholders: manufacturers, operators, infrastructure managers, the European Commission, EU Member States, academics and users' groups. Its mission is to deliver a vision of the railway's future enabled by Research and Innovation activities.

The Master Plan provides guidance for the Europe's Rail Joint Undertaking's more specific tasks, namely:

- develop in its System Pillar a system view that reflects the needs of the rail manufacturing industry, the rail operating community, Member States and other rail private and public stakeholders, including bodies

[12] https://rail-research.europa.eu/wp-content/uploads/2020/12/RAIL-Strategic-Research-and-Innovation-Agenda-2020-_FINAL_dec2020.pdf

representing customers, such as passengers and freight and staff, as well as relevant actors outside the traditional rail sector.

The 'system view' shall encompass:

- the development of the operational concept and system architecture, including the definition of the services, functional blocks, and interfaces which form the basis of rail system operations;
- the development of associated specifications including interfaces, functional requirement specifications and system requirement specifications to feed into Technical Specifications for Interoperability (TSI) established pursuant to Directive (EU) 2016/797 or standardisation processes to lead to higher levels of digitalisation and automation;
- ensuring the system is maintained, error-corrected and able to adapt over time and ensure migration considerations from current architectures;
- ensuring that the necessary interfaces with other modes, as well as with metro and trams or light rail systems, are assessed and demonstrated, in particular for freight and passenger flows;

- perform the research and innovation activities necessary to achieve the objectives of EU-Rail, including low TRLs rail-focused research and innovation activities. In that respect, EU-Rail shall:

- define and organise the research, innovation, demonstration, validation and study activities to be carried out under its authority, while avoiding fragmentation of such activities;
- exploit standardisation and modularity opportunities, and facilitate the interfaces with other modes and systems;
- develop demonstration projects;
- develop close cooperation and ensure coordination with related European, national and international research and innovation activities in the rail sector and beyond as necessary, in particular under Horizon Europe, thereby enabling the Europe's Rail Joint Undertaking to play a major role in rail-related research and innovation while also benefiting from scientific and technological advances reached in other sectors;
- perform any tasks necessary to achieve the objectives set out in SBA Articles 4 and 85.

- facilitate the market uptake of rail innovation developed in the Europe's Rail Joint Undertaking and to support deployment of the innovative solutions through the establishment of a Deployment group pursuant to Article 22 of the SBA.

Five areas of priority for EU-Rail have been determined in its Master Plan:

1) European rail traffic management and supporting rail's key role in a multimodal transport system

2) Digital and automated train operations

3) Sustainable and digital assets

4) Competitive digital green rail freight

5) Smart solutions for low density traffic lines (cost-efficient regional lines)

These priorities will be underpinned by a system view to ensure a harmonised approach to the evolution of the Single European Rail Area. They will be complemented by forward-looking activities, tackling disruptive technologies and thinking, through performing exploratory research and other complementary activities.

EXECUTIVE SUMMARY

The R&I activities performed under the new EU-Rail integrated Programme are covering innovative solutions' lifecycle, from exploratory research to pre-implementation and deployment, are designed to deliver the transformation of the rail sector needed to answer clients' needs, passengers and supply chain. Not only to contribute addressing the European Green Deal but also the energy crises and new competitiveness challenges.

The established System Pillar works in 2024 provided the first outputs including:

- First Version of Standardisation and TSI Input Plan - approved and published
- Trackside Assets specifications update (TACS/EULYNX Baseline 4 Release 3) – approved and published
- CCS/TMS Data Model V1 – approved and published

In the Innovation Pillar in 2024, following the launch of the first 6 Flagship projects in December 2022, the monitoring of the activities and assessment of the results continued in 2024 in view of the fulfilment of the main milestones ahead of their conclusions in 2026. 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.

Eight new Grant Agreements were signed (stemming from the 2023 and 2024 Call for proposals) for projects covering FA2 "Digital & Automated up to Autonomous Train Operations - in synergy with the European Smart Networks and Services Joint Undertaking (SNS JU) on testing and validating Version 2 of the FRMCS specifications, FA7 "Innovation on new approaches for guided transport modes" on Hyperloop. While initially foreseen in 2024, the signature of a Grant Agreement in FA5 "Sustainable Competitive Digital Green Rail Freight Service" related DAC was however postponed to Q1-2025. Additionally, in 2024 EU-Rail kick-started the second set of Exploratory research activities with 6 new Grant Agreements, complementing the work of the FPs in often different areas of research and innovation of the EU-Rail Innovation Pillar.

Deployment activities are also a central activity of EU-RAIL. As such, 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. In addition, the EU-RAIL Deployment Group has been formally established, and it has been agreed that FRMCS is the first topic on which to form a subgroup.

Beyond the operational activities, 2024 was the third year of implementation of Article 13 SBA, where EU-Rail took over the responsibility for the coordination of the Back Office Arrangement (BOA) Accounting Services. Other 3 BOAs led by other JUs were operationalised, where EU-Rail also took a supporting role.

The year 2024 sought the continuation of the close collaboration established between EU-Rail and:

- the European Railway Research Advisory Council (ERRAC),
- the European Union Agency for Railways (ERA),
- other programmes, partnerships and other bodies, with the objective to establish synergies that will result in coordinated and consistent activities, or joint R&I projects or administrative synergies,
- different associations representing the key stakeholders of the rail sector and beyond,
- third countries programmes, in line with the policy priorities of the Commission and considering the key objective of the competitiveness of the European rail industry.

The JU's key messages and events continued to reinforce the objectives of the initiatives such as the European Green Deal, the Sustainable and Smart Mobility Strategy or the Digital Decade and European Competitiveness by disseminating R&I results and showing the future evolution of rail in terms of services for passengers and freight clients. In this respect, in line with its communications strategy, Europe's Rail aims to:

- showcase the innovative technological and operational solutions that result from the research and innovation activities, and in particular those ready to enter industrialisation and deployment, in particular demonstrating concrete impact;
- raising awareness on the research and innovation activities outreaching to the stakeholders at European level as well as engaging at global events/conferences to promote Europe's Rail results;
- enhance the partnership nature of the JU through communications and dissemination activities that will create opportunities for inclusiveness.

For this, it is worth noting that in 2024 the JU also undertook a complete revamp of its corporate website.

EU-Rail finalised its Phasing-Out Plan, approved by the Governing Board in November 2024, highlighting the steps for the administrative closure of the Programme, without precluding a possible continuation of the Union investment in a possible successive partnership under the next Union's Framework Programme, in accordance with the SBA. At the same time it initiated a reflection on the future of rail R&I within a policy-driven public-private partnership and published a draft High-level Paper.

2024 included also as significant effort from the Programme and Corporate Services teams to successfully close the final assessment and payment of the Shift2Rail Programme. The payment implementation reached the 99.4% of the maximum available funding which represent a successful R&I programme financial implementation and the S2R Members validated EUR 25.6 million IKOP above the regulatory obligation and EUR 147,6 million IKAA above the regulatory obligation.

Mr Giorgio Travaini was appointed by the EU-Rail Governing Board as Executive Director of Europe's Rail Joint Undertaking on 22 May 2024, and Mr. Vasileios Chatzigeorgiadis has been recruited on 1 July 2024 as Head of Corporate Services.

S2R Programme Status

2024 was a closing year for administrative and financial activities under the innovation programmes of Shift2Rail. All the technical demonstrators were finalised in 2023 and results already reported, demonstrating their results after 7-8 total years of programme implementation since its launch, in advance to the S2R JU Programme implementation end date of 31 December 2024.

S2R Programme Management

In terms of Programme Management, 2024 was the fifth year during which reviews of Lump Sum projects took place. Experience confirms so far has shown that from an operational perspective the use of Lump Sum for members' projects does not only result in an administrative simplification, but also effectively bundles efforts in the project review to focus on the achievements of results. The fact that the proof of concluded work packages (hence related focus on deliverables and milestone approval) provides the basis for the reimbursement of costs has allowed the JU and consortia to focus their efforts in an effective way in order to ensure the delivery of the projects.

2024 Programme Management continued to be influenced by the need to continue monitoring projects affected by the pandemic consequence of previous restrictions. The Programme Management was also characterised by a with focus on results and achievement of the Reporting and Payment planning for 2024.

With a holistic approach, the role of the JU is also to ensure that interactions between the various IPs are adequately considered and managed, as technological developments in one part of the system could lead to changes in performance, or even create barriers, in other parts. In addition, cross cutting activities include research on long-term economic and societal trends such as customer needs and human capital and skills, which must be taken into account by the different IPs.

EU-Rail Programme Status

In general, the objectives of the integrated Programme include the following:

- contribute towards the achievement of 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.

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.

The System Pillar provides governance, resource, 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 brings rail sector representatives under a single coordination body.

To achieve this, the System Pillar will deliver a unified operational concept and a functional, safe and secure system architecture, with due consideration of cyber-security aspects, focused on the European railway network to which Directive 2016/797 applies (i.e. the heavy rail network), for integrated European rail traffic management, command, control and signalling systems, including automated train operation which shall ensure that research and innovation is targeted on commonly agreed and shared customer requirements and operational needs, and is open to evolution.

The outputs of the System Pillar Tasks and Domains are detailed in section 1.3.1.

The Innovation Pillar

The Innovation Pillar is set up to deliver user-focused research, innovation and large-scale demonstrations. It is tasked to deliver the operational and technological solutions which provide the necessary capabilities to transform the European rail system. Its activities are organised in seven Flagship Areas and the Transversal Topic.

In 2024, the Flagship Projects responsible for undertaking the initial implementation of these Flagship Areas continued their activities. On the basis of the preparatory work done in 2023, all projects have continued working on use cases, requirements and development of specifications, as preparation for future prototype development ahead of testing in the second of these projects (foreseen from 2025 onwards). All FPs have also continued collaborating among themselves, as well as with the EU-RAIL System Pillar.

Eight new Grant Agreements were signed (stemming from the 2023 and 2024 Call for proposals) for projects covering FA2 "Digital & Automated up to Autonomous Train Operations - in synergy with the European Smart Networks and Services Joint Undertaking (SNS JU) on testing and validating Version 2 of the FRMCS specifications, FA7 "Innovation on new approaches for guided transport modes" on Hyperloop. While initially foreseen in 2024, the signature of a Grant Agreement in FA5 "Sustainable Competitive Digital Green Rail Freight Service" related DAC was however postponed to Q1-2025. Additionally, in 2024 EU-Rail kick-started the second set of Exploratory research activities with 6 new Grant Agreements, complementing the work of the FPs in often different areas of research and innovation of the EU-Rail Innovation Pillar.

The outputs of the Innovation Pillar are detailed in section 1.3.2.

The EU-Rail Deployment Group

As per Article 97 of the Single Basic Act, the Deployment Group is to advise the Governing Board on the market uptake of rail innovation developed in EU-Rail and to support the deployment of innovative solutions.

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. 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.

During 2024, following the Governing Board Decision No 11/2023 EU-RAIL has organised and finished the set up of the High Level Deployment Group. First three meetings in 2024 had an informal character, due to the fact that the EC hadn't taken the final decision on the composition. The Group was formalised November 2024. A kick-of meeting, and two meetings on procedures and first topic (FRMCS).

In these meetings RoP, Communication plan and Rules of appointing subgroups were discussed and informally decided. Formal decisions will be taken in the first -now formal- meeting of 2025.

It was agreed FRMCS as the first topic to focus on a subgroup. A dedicated subgroup was set up on European FRMCS Deployment. For this group remits and working plan was discussed and set as basis for the works. Five informal meetings of the FRMCS subgroup were held in 2024. Three Working groups were set up. 1. WG technology, 2 WG legal and finance 3. WG migration and alignment.

The European DAC Delivery Programme under the leadership of EU-Rail

In July 2020, the Governing Board of the JU endorsed the creation of the EDDP proposed by the ED, voicing 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 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. This activity constitutes a major step ahead of the digital rail freight, enabling new operations and services that will contribute meeting the expectations of the Sustainable and Smart Mobility Strategy of the European Commission.

The EDDP integrates, with an independently managed delivery programme, 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 2024 several meetings continued with the ERA DAC Topical Working Group and national NSA's with the aim to agree a DAC spec that could be adopted in future TSI, supporting the harmonization all across EU rail network.

In 2024, 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 via regular reports in the EDDP boards. Regular alignment meetings took place between the different bodies and, in coordination with the EU-Rail JU. This work is continued through executing and managing the DAC General Master Plan. It further worked on the DAC migration roadmap and on a EDDP Stakeholder Management.

An updated DAC CBA was coordinated in EDDP and led by the European Commission, followed by the creation of a Task Force on Intermodal Traffic with stakeholders from Intermodal and EDDP to better reflect Intermodal aspects in the CBA. This WP permanently interacted with all other DACCord WPs and with FP5-TRANS4M-R. The activities on regular cross-coordination of the works of the EDDP, FP5 and EU-Rail System Pillar (Task 4) continued along 2024.

Furthermore, the project supported the work of the migration roadmap update, especially on the collection of the European vehicle fleet data (DACFIT). The project also worked together with FP5 TRANS4M-R project for setting-up three so called EU-Rail "sounding boards". The results of these sounding boards were reported to the EDDP programme board and used for evaluation by the FP5 TRANS4M-R project.

Other activities

The EU-Rail Staff Establishment Plan covering, from the resources needs perspective, the EU-Rail activities of 2024, was adopted by the Governing Board on December 2023. In November 2024 the GB adopted the Staff Establishment Plan for 2025-2026 including 3 staff members of the Back Office Accounting arrangements, which covers accounting services for all Joint Undertakings. According to the Staff Establishment Plan applicable to 2024, EU-Rail should have been staffed with 32 staff members including 2 Seconded National Experts. As a consequence of the revision of the Multi-Annual Framework with a reduction of the Horizon Europe amount, as well as the signature of the association Agreement with the UK, one CA position was 'transformed from a position funded by the EU to a position funded by Third countries without having an impact on the total number of the EU-RAIL staff, this is applicable as of 2025, as well as an additional TA post financed from external revenues. In 2024, the JU experienced three departures of staff members and the vacant posts were progressively filled in. To fill temporary gaps or long-term absences, the JU also made use of external competencies and expertise to achieve its operational activities, as well as of temporary outsourcing of some administrative tasks.

With regard to communication and dissemination activities, the JU focussed primarily on the supporting activities of the Europe's Rail Joint Undertaking, with a particular focus on the continued promotion of the S2R Programme bringing as much visibility as possible to the results of its R&I activities, while also raising awareness of the Europe's Rail Programme, its Calls for Proposals, System and Innovation Pillar, and the newly established Deployment Group. 2024 marked the year of the conclusion of the Shift2Rail projects.

Particular focus was placed as well on the promotion of the objectives and outputs of the EU-Rail Flagship Projects.

Furthermore, project results were disseminated through its social media channels as well as at various events with Europe's Rail participation, including at the InnoTrans 2024, The Connecting Europe Days 2024 and the Transport Research Arena (TRA).

In addition to the efforts on stakeholder involvement, the JU further continued improving its internal organisation as to provide continuous support to its Members and beneficiaries. Attention was paid to the continuous implementing of the internal control framework and to the assessment and management of risks. The JU cooperated with different stakeholders engaged in audit activities, such as the European Court of Auditors, the Internal Audit Service of the Commission, the Common Audit Service of DG RTD (even though not anymore supporting EU-Rail in performing the ex-post activities and EU-Rail launched in 2024 two ex-post review following CAS indication of selection for the Horizon Europe indicators) or the external auditors auditing the Annual Accounts of the JU. All of these activities have contributed to the continuous assurance regarding the sound financial management of EU funds managed by the Joint Undertaking. Moreover the EU-Rail Horizon Europe Control Strategy for grants has been updated in 2024 to reflect this change.

In 2024, the JU submitted to the European Parliament a follow-up report on Parliament's observations provided in its Resolution related to the decision on discharge in respect of the implementation of the JU's budget for the financial year 2022. In this follow-up report, the JU explained its way in which it addressed these observations or intends to address them in the upcoming period. More specifically, it was elaborated, besides other, on how EU-Rail contributes to the EU goals related to transport (e.g., a zero-emission, silent rail system and climate resilient infrastructure; an integrated European railway network which is more attractive, affordable and easy to maintain, etc.). In response to some HR-related issues that were pointed out by the Parliament, the JU explained the objective conditions in which it operates, and the feasible actions that it took in that area. At the same time, the JU explained its opposed view on the conclusions drawn by the European Court of Auditors on the implementation of a structured risk-based approach to ex-ante controls and has further clarified the risk control strategy that was implemented. Furthermore, the JU has provided further details on the actions taken to address the observations on the presentation of the programme funding in the annual accounts and the budget implementation.

It can be concluded that thanks to the commitment of both the JU Members and the Programme Office, 2024 has seen the JU further continuing its important progress towards delivering the EU-Rail Programmes.

The next sections of this 2024 CAAR present in detail the achievements, risks and opportunities, and the developments pertaining to the JU during the past year.

Key objectives 2024, associated risks and corrective measures

European Green Deal, the United Nations Sustainable Development Goals, the Sustainable and Smart Mobility Strategy and the Digital Decade

The European Green Deal was presented in December 2019, setting out a clear vision of how to achieve climate neutrality in Europe by 2050[13]. Transport accounts for a quarter of the EU's greenhouse gas emissions, and still growing. To achieve climate neutrality, a 90% reduction in transport emissions is needed by 2050. As a matter of priority, a substantial part of the 75% of inland freight carried today by road should shift onto rail and inland waterways.

"To transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use." (European Green Deal, p. 2).

Priority areas include accelerating the shift to sustainable and smart mobility: "Automated and connected multimodal mobility will play an increasing role, together with smart traffic management systems enabled by digitalisation. The EU transport system and infrastructure will be made fit to support new sustainable mobility services that can reduce congestion and pollution, especially in urban areas" (European Green Deal, p. 10).

In July 2021, the so-called "Fit for 55"[14] package was introduced by the Commission – a package consisting of a set of inter-connected proposals making the existing legislation more ambitious, where possible, and even putting on the table new proposals, where needed. The main ambition of the EU under this package is cutting emissions by at least 55% by 2030 by also supporting a faster roll-out, relative to prior objectives, of sustainable transport solutions such as rail. Overall, the package strengthens eight existing pieces of legislation and presents five new initiatives, across a range of policy areas and economic sectors: climate, energy and fuels, transport, buildings, land use and forestry.

The European Green Deal is also an integral part of the Commission's strategy to implement the United Nation's 2030 Agenda and the 17 Sustainable Development Goals (SDGs).[15] The JU has been reporting in its Consolidated Annual Activity Reports already under the S2R Programme on its contribution to the SDGs since 2018. The Joint Undertaking, under its current Programme, will continue in this endeavour, more specifically with regard to these SDGs[16]:

SDG 9: Building resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

SDG 12: Ensure sustainable consumption and production patterns

SDG 13: Take urgent action to compact climate change and is impacts

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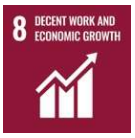
13 European Commission (2019). The European Green Deal. COM(2019) 640 final, Brussels

14 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021DC0550 and https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55-the-eu-plan-for-a-green-transition/

15 United Nations General Assembly (2015). Transforming Our World: The 2030 Agenda for Sustainable Development. Draft resolution referred to the United Nations summit for the adoption of the post-2015 development agenda by the General Assembly at its sixty-ninth session. UN Doc. A/70/L.1. New York

16 As also indicated in the Biennial Monitoring Report 2022 on Partnerships in Horizon Europe, page 295: https://op.europa.eu/en/publication-detail/-/publication/a6cbe152-d19e-11ec-a95f-01aa75ed71a1/language-en/format-PDF/source-search



SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

SDG 5: Achieving gender equality and empower all women and girls

More specific insights into how EU-Rail aims at contributing to the broader objectives represented by the SDGs can be obtained from Annex E and Annex F providing information on the Key Performance Indicators/Key Impact Pathway Indicators.

Further to the above, the Sustainable and Smart Mobility Strategy of the Commission, launched in December 2020[17], includes more concrete milestones for the railway sector to enhance a smart and sustainable future. Its underlying Action Plan of 82 initiatives lays the foundation for how the EU transport system can achieve its green and digital transformation and become more resilient to future crises. In particular, it provides the visionary ambitions that the next rail R&I Programme will have to contribute to insofar as possible and notably:

- By 2030 the high-speed rail traffic will increase by 50%; the scheduled collective travel of under 500 km should be carbon neutral within the EU and automated mobility will be deployed at large scale.
- By 2050 rail freight traffic will double; high-speed rail traffic will triple and the multimodal Trans-European Transport Network (TEN-T) equipped for sustainable and smart transport with high-speed connectivity will be operational for the comprehensive network.
- A shift of a substantial part of the 75% of inland freight carried by road towards transport by rail and inland waterways.

Additionally, rail transport will also need to be further electrified; wherever this is not viable, the use of hydrogen should be increased. And the roll out of the European Rail Traffic Management System (ERTMS) will be pursued including further efforts to develop train automation, for instance through joint undertakings.

Further to the topic of "Digital Decade", the Commission indicated in its Communication of March 2021[18] how digital transformation can improve the ecosystems related to mobility and transport. Digitalisation can improve environmental and cost performance and simultaneously increase safety levels contributing to a higher quality of life. It will be achieved through more advanced levels of automation, faster and more reliable connectivity, and IT enabled profound transformation of the management of mobility services. The public could also benefit from fast internet connectivity for passengers on most stations and lines, user-oriented telematics and facilitated multi-modality.

In this context, EU-Rail and its Programme strived for speeding up the development and deployment of innovative technologies in railway transport in order to contribute to achievement of the above-mentioned milestones. This will require a significant transformation of the railway sector, addressing long overdue changes in legacy operational processes, systems and governance models, as well as integrating with other transport and mobility solutions for passenger services and cargo logistics. The ongoing energy crises, which has major impacts also on rail, requires accelerating research and innovation towards deployment of innovative technological and operational solutions that would contribute to operational efficiencies and energy performance.

Besides the efforts made via its R&I Programme, the JU itself and its staff, to the extent corresponding to the size of the organisation, also strived to contribute to the fight against climate change when conducting the day-to-day business. Those "little things" that the JU applies to be as green as possible include:

[17] European Commission (2020). Sustainable and Smart Mobility Strategy – putting European transport on track for the future. COM(2020) 789 final, Brussels

[18] European Commission (2021). 2030 Digital Compass: the European way for the Digital Decade. COM(2021) 118 final, Brussels

- Separating waste in the JU's premises,
- Suppression of single-use items,
- Reducing paper consumption by applying paperless workflows to the extent possible,
- Encouraging staff not to commute to work by car by providing a scheme for reimbursement of public transport cost and arrangements supporting commuting by bike.
- Increased usage of online/hybrid meetings and events to reduce the carbon footprint related to travelling.

While the option of moving office in 2022 or early 2023 was eventually not realized, any future decision-making of EU-Rail in this respect will include due considerations regarding the energy-efficiency parameters of the respective premises.

Key objectives 2024

The JU objectives of 2024 were met with the full commitment of the budget appropriations (99.5%) related to the Horizon Europe funded EU-Rail Programme for the operational activities for that year. This demonstrates that the JU was able to engage the railway sector to an effective resource commitment to progress in delivering the railway system evolution, through an increasingly integrated Programme.

The Work Programme (WP) and budget 2024, initially adopted in December 2023, were amended on two occasions mainly to address the updates regarding operational activities and the related financial figures:

(1) The WP Amendment no. 1 adopted in February 2024 recognized the inscription of EUR 32.9 million of payment appropriations on Title 3 of the Budget 2024 to ensure the closure of the remaining S2R projects.

(2) The WP Amendment no. 2 adopted in November 2024 adapted the budget both in commitment and payment appropriations considering the evolution of budget needs, the multi-annual operational planning of EU-Rail, and finally to amend the multi-annual IKAA plan 2023-2024 following a proposal of private founding members.

The progress achieved and the launch of these additional core activities represented another key step towards the digitalization and automation of the railway system, to contribute delivering sustainable (climate neutral, life cycle cost efficient, connected, integrated through a system approach) mobility and transport for passengers and supply chain.

In 2024, and indicatively in 2025, the operational priorities consisted of:

- Innovation Pillar:
    - The monitoring and performance analysis of the continued work of the Flagship Projects (begun in 2022), including the achievement of the planned milestones, in preparation for the demonstration activities of 2025 and 2026 → achieved;
    - The ramp-up, following the conclusion of the grant agreements in 2024, of the projects resulting from the Call 2023-1 that as part of the Integrated Programme complement the Flagship Projects with additional Exploratory research activities and enlarge the horizon of rail ability to serve European citizen with the development of tools, digital platforms and services for a better integration of aviation and railway transport modes, in collaboration with SESAR 3 JU, → achieved;
    - the launch of the Call 2024-1 during Q1 2024, followed by the conclusion of the grant agreements, to create new opportunities for inclusiveness and participation, enlarging the Flagship Projects with additional anticipated activities of the related Flagship Areas, as well as provide a platform for more disruptive innovation linked to hyperloop technologies and concepts, → achieved;
- System Pillar:
    - the delivery of the results of the System Pillar Tasks and Domains, including the first Standardisation and TSI Input plan to the European Commission and verify in the mid of 2024 → achieved;

- the launch of the contract to support activities in 2025 → achieved;

- Deployment Group:
  - The operationalization of the high-level and topical working group(s) in 2024, following the GB decision for their creation, aiming at closing the innovation gap towards deployment with addressing European migration and implementation plans, → achieved;
  - supporting the activities of the European DAC Delivery Programme (EDDP), in particular working with the European Commission towards the development of a comprehensive migration strategy to coordinate deployment, in accordance with the Commission communication on "Greening Freight Transport" COM(2023) 440, → achieved and ongoing;

- Membership:
  - the preparation of a call for expression of interest to select Associated Members, in accordance with articles 7 and 87(1) point c of the SBA , to be launched by the JU by the end of the first half of 2024, after having made an in-depth assessment of the EU-Rail Programme, an update of the Multi-Annual Work Programme (MAWP), and after identifying possible gaps to be filled by new entities' commitment. → achieved;

In addition, the year 2024 saw the continuation of the close collaboration established between EU-Rail and:

- the European Railway Research Advisory Council (ERRAC),
- the European Union Agency for Railways (ERA),
- other programmes, partnerships and other bodies, with the objective to establish synergies that will result in coordinated and consistent activities, or joint R&I projects or administrative synergies, such as for example under the Back-office arrangements with other JUs,
- different associations representing the key stakeholders of the rail sector and beyond,
- third countries programmes, in line with the policy priorities of the Commission and considering the key objective of the competitiveness of the European rail industry.

Finally, in 2024, continued conveying the message to European citizens that rail can answer their concerns about unsustainable and unreliable mobility options. The JU's key messages and events continued to reinforce the objectives of the initiatives such as the European Green Deal, the Sustainable and Smart Mobility Strategy or the Digital Decade by disseminating R&I results and showing the future evolution of rail in terms of services for passengers and freight clients. In this respect, in line with its communications strategy, Europe's Rail aims to:

- showcase the innovative technological and operational solutions that result from the research and innovation activities, and in particular those ready to enter industrialisation and deployment, in particular demonstrating concrete impact;
- raising awareness on the research and innovation activities outreaching to the stakeholders at European level as well as engaging at global events/conferences to promote Europe's Rail results, for example the successful collaboration with DG MOVE and ERA on the joint stand at InnoTrans 2024;
- enhance the partnership nature of the JU through communications and dissemination activities that will create opportunities for inclusiveness.

At the corporate level, EU-Rail strives for appropriate workload distribution, as well as for costing and staffing levels needed to ensure successful delivery of the Programme. In addition to supporting continuous learning and qualification raising of the staff, activities improving the well-being and team cohesion were conducted throughout 2024.

The following sections of this CAAR describe how the JU's objectives have been pursued, the activities performed on the way towards achieving its goals, and the resources used. In Annexes E and F, the JU's performance is measured against the set of agreed KPIs.

More details related to call for tenders, procurements and contracts concluded and/or launched in 2024 are presented in Sections 1.4 and 2.5.

Delivery of S2R Programme R&I activities

During 2024, there was a contractual closing of all H2020/S2R project activities.

101 Projects of the S2R Programme[19], awarded and signed since 2016, were concluded and resulted in a total R&I total value, including only the accepted payments, of EUR 764,3 million. Additionally, and 13 operational tenders implementing part of the Programme were closed.

Risks

In Q4 2023, the JU performed a risk assessment exercise with the aim of updating the elements related to risks and opportunities already included in its risk register, as well as identifying potential new ones. The corresponding risks relevant for 2024 associated with the Programme activities and the financial administration of the JU, requiring continuous ED attention (and when relevant, the attention of GB), as well as the corresponding risk mitigating actions have been communicated via the EU-Rail Work Programme 2024. They are summarised in the table below together with an update on follow-up and mitigation actions performed in 2024.

As for the average JU's risk profile pertaining to 2024, as followed from the annual risk assessment performed, and also from the continuous monitoring of risks and opportunities during the year, this was determined by having moderate to high net criticality of the most relevant risks identified.

Risk identified for 2024 in the Work Programme	**Action plan/measures**	**Follow-up on action plan/measures for 2024**
Proposals of participants submitted in response to JU's calls do not adequately reflect in the part providing the foreseen budget of the action the current and future expected inflation rate. This might have negative influence on the successful delivery of the work packages at a later stage of the projects.	- Continuous Programme monitoring will be instrumental to assess the capacity to deliver the programme in the determined resources or anticipate the need for prioritization and adjustments. - Drawing the attention of potential applicants on this issue during the Info Days.	Actions/measures have been implemented on an ongoing basis. Info Days or other communication opportunities were used to also point out the importance of adequate anticipation of development in price levels. As a result of the internal programme a mid-term review of 2025 will take place to reorganise the Programme and reallocate contributions/IKAA, if needed
Intrinsic to the JU's Staff establishment plan and its actual fulfilment, efficiency of operations is impacted by extensive workload of JU's staff. In combination with high staff turnover, difficulties for the JU to attract new people, vacant positions might be filled with delays resulting in shortage of resources becoming critical especially during peak periods.	Continue in conducting recruitments for reaching the actual staffing according to the EU-Rail Staff establishment plan – once accomplished, the envisaged positive effects on workload allocation and back-ups should become visible.- Design/apply a replacement plan (back-ups) where possible.	Actions/measures have been implemented on an ongoing basis: Vacant posts as per the new Staff Establishment Plan have been gradually filled. Internal planning and organisation were refined.

[19] 4 Light house projects (2015) not included.

Risk identified for 2024 in the Work Programme	Action plan/measures	Follow-up on action plan/measures for 2024
Specific accumulation of tasks and activities following from the transition between the two JUs and from launching of the new Programme may also contribute to difficulties in getting the work done in time and in the desired quality, deteriorating employees' motivation and, eventually, jeopardizing achievement of the JU's objectives.	- Within the current budget constraints, a career plan for staff has been prepared and business continuity is ensured. - Enhancing of the overall planning of activities will allow for better personnel risk management. - Recruitment of short-term resources (interim or trainees) has been extended. - Outsourcing of some activities, as applicable, making use of existing Framework contracts or by executing own procurements. - Implementation of back-office arrangements among the JUs might decrease the EU-Rail's internal workload in some areas. - Introduction of a multi-annual learning and development policy will be considered. - Flexible arrangements within the bounds of the respective Commission Decision are in place with regard to hybrid working. - Initiatives aimed at ensuring good working environment and team spirit are implemented on a regular basis, such as social events and team building activities. - Individual and group sessions were organized in 2023 with professional coaches to find strategies, tips and tricks about how to foster the wellbeing at individual staffs' level and also when interacting in the team.	Bluebook Trainees were deployed in accordance with the SLA signed with DG EAC, as needed. Synergies under BOA HR have been utilised. Activities aimed at enhancing team spirit and work-life balance have been carried out. Outsourcing of some activities, as applicable, making use of existing Framework contracts or by executing own procurements.
Given the interdependencies of complementary R&I projects, considering as well the startup of a complex and integrated new Programme (including input/outputs between System and Innovation Pillars), delays and misalignments in the completion of activities may lead to negative project cascading effects impacting Programme outputs.	- Ensure, through adequate Programme management strengthened monitoring and reporting of projects, including gate reviews, to determine whether specific actions need to be taken with regard to a specific project (re-orientation, early closure, etc.). - Addressing during the GAP any possible alignment issues between ongoing and future R&I activities.	Measures have been implemented on an ongoing basis: Adequate Programme monitoring was continuously ensured and any issues related to the R&I projects were addressed.

Risk identified for 2024 in the Work Programme	Action plan/measures	Follow-up on action plan/measures for 2024
	- Follow the high-level interactions as detailed in the MAWP. - Application of maturity check points.	
The ambitions of the System Pillar sector/EU are not matched by the outcomes of EU-Rail Programme due to the limitation in terms of available resources to cover the related activities. This might negatively affect the image of the JU.	- Analysis of feasibility of requirements expressed by the sector and appropriate management of expectations. - Application of shorter contractual periods. - Checking of contract deliverables by third parties, for example ERA, and third-party experts. - Constant communication on outputs, focusing on concrete results that can be implemented taking into account the legacy system, migration aspects, business cases, etc. - Request to the contractor evidence allowing matching the foreseen outputs with resources allocation.	Measures have been implemented on an ongoing basis: Adequate continuous management of the System Pillar activities was carried out including communication with the relevant stakeholders.
Breach of intellectual property rights due to unauthorised access and misuse of information related to EU-Rail's Programme by contractors or subcontractors of the Commission, such as service providers maintaining the EC-owned IT tools/systems used for Programme management purposes (SyGMa, Compass, Corda, Cortex, etc.). If materialized, the situation could have an impact on EU-Rail e.g., in terms of disruptions of good relations with the respective JU's member/beneficiary, or even financial and reputational impact (stepping out from the project(s)/Programme, litigation, etc.).	- Communication by the JU about this risk towards the Commission. - Requesting the Commission for normal recognition of this risk and for confirmation that measures are applied at their side to mitigate this risk.	Measures have been implemented on an ongoing basis: DG MOVE was provided with the JU's risk register.
Due to deployment/application of diverse processes, methods and tools, the integration between the Flagship Projects and the System Pillar could experience problems, including negative effects on inputs for specifications and standards, and overall architecture. Therefore, the effectiveness of management of the Programme	- Continuous efforts to converge on common approaches. - Correct utilisation of System Pillar tools and processes for architecture and specification work. - Clearly defined IT framework. - Clearly defined processes.	Actions have been implemented on an ongoing basis. Meetings of the System Pillar Steering Group and of the ED System and Innovation Programme Board were held.

Risk identified for 2024 in the Work Programme	Action plan/measures	Follow-up on action plan/measures for 2024
as a whole could suffer, eventually jeopardizing achievement of the Programme objectives.		
Unbalanced distribution of personnel and technical capacities of the participants to JU's R&I projects between the ongoing ones (S2R Programme) and the new ones (EU-Rail Programme), e.g., due to unjustified preferences of the participant or overall lack of capacities, might result in difficulties with parallel delivering of outcomes of the S2R/EU-Rail Programmes and thus jeopardizing the JU's key objectives.	- Addressing the potential issues in the GAP phase of the new EU-Rail projects. - Ongoing monitoring of projects and actions and timely reactions to identified issues at project/participant level. - Formal reminders sent for projects with delay of more than 30 days.	Measures have been implemented: Adequate monitoring of S2R/EU-Rail Programmes was continuously ensured and any issues related to the R&I projects were addressed. Meetings of the ED System and Innovation Programme Board were held.
Vulnerabilities in IT infrastructure or human failures/omissions enabling unauthorized computer network access or cyber-attacks may lead to compromising of data with potential financial losses and/or reputational damage. Delays might also occur, e.g. if data relevant to day-to-day operations became unavailable due to a successful ransomware attack.	- VPN connection encryption. - Two-way authentication. - VLANs used for LAN segmentation/ separation. - Secured guest Wi-Fi, LAN-independent. - Cybersecurity testing with regard to the Cooperation Tool and website. - Computer disk encryption in place. - Lock, change user password remotely; intunes security policy for mobile phones. - Implementing the mitigation measures resulting from the DPIA performed with regard to the migration to Office365. - Continuous awareness-raising of JU's staff members with regard to cyber security and protection of IT tools and assets. - Sharing of information with the staff about detected actual phishing attempts (also from the EC or other EU bodies) and providing advice on the appropriate way of procedure in such cases. - Joint ICT strategic plan for all JUs is in place, which foresees i.a. the implementation of the EC authentication method for the JU infrastructure and the implementation of	Technical measures have been implemented on an ongoing basis. Several reminders and awareness-raising activities to JU's staff were provided with regard to cybersecurity and phishing. Joint activities among the JUs were carried out in the context of BOA. Application of business continuity measures in case the risk materialized.

Risk identified for 2024 in the Work Programme	Action plan/measures	Follow-up on action plan/measures for 2024
	a new regulation for a close cooperation with all EU bodies in terms of cybersecurity and data protection.	
Timely and qualitatively adequate execution of the daily Programme management activities may be jeopardized due to accumulation of tasks within the SyGMa/Compass workflows (GAP for the new projects in combination with REPA for the existing projects). This could result, for example, in late payment or late delivery of approval of reports/deliverables, or even delaying the start of a grant.	- Increased frequency of meetings between the Executive Director and the Heads of Units to monitor the current status of workflows and possible delays. - Increased intensity of the current status monitoring by the Heads of Units. - Temporary partial reassignment of tasks of some of the existing staff members to support the POs, FOs and LOs involved in the respective SyGMa/Compass workflows. - Potential deployment of temporary external resources allowing POs, FOs and LOs involved in the respective SyGMa/Compass workflows transferring some of their clerical/administrative tasks to such temporary external resources.	Measures have been implemented on an ongoing basis. Adequate planning and follow-up were carried out to ensure proper management of the Programme.
Failure to achieve the requirement of Article 13 of the SBA, starting with the assessment of the cost effectiveness of the possible services to be included in the back office arrangements (BOA), may result in a missed opportunity to achieve efficiencies. It may also represent a non-compliance with the respective provisions of the SBA with a negative impact on JU's reputation. In addition, the lack of clarity may negatively impact the JU's staff in terms their motivation, should the BOA arrangements experience delays.	- Utilisation of the flexibility that the SBA provisions provide regarding BOA so as to find the best possible solutions with regard to their practical establishment. - Preparing a proper planning of implementation, with efficient monitoring and regular meetings at appropriate level (EDs, Heads of Units) to discuss the modalities of BOA, including setting up the SLAs, with the support of DG BUDG and DG RTD (CIC). - Involvement of decision-making bodies (GBs). - Steering of the process and active guidance is ensured by the Commission via DG RTD. - Early involvement of the respective EU-Rail staff members. - Timely launch and execution of recruitment procedures to hire additional EU-Rail staff for the purposes of the accounting BOA.	Actions have been implemented on an ongoing basis. BOA for accounting services is fully operational. Progress has been made in establishing SLAs for other services (IT, HR, procurement) (see also Section 2.7.2). Adequate planning and coordination were ensured at various levels among the JUs. GBs were kept updated on the BOA developments.
Deficiencies in dissemination of results may develop in vague information to the end-user/interested parties and could compromise the intended JU's	- The JU provided a series of guidelines to the projects and fostered the use of the H2020 instrument as the Common Dissemination Booster.	Actions/measures have been implemented on an ongoing basis.

Risk identified for 2024 in the Work Programme	Action plan/measures	Follow-up on action plan/measures for 2024
impact. That can also negatively impact the overall reputation of the EU-Rail Programme.	- Proper planning and regular follow up at IP SteCo/SIWG and within the projects' control gates. - Point of monitoring and analysis under the maturity checkpoints. - Demos at EU-Rail stand at InnoTrans and other relevant events. - Every time possible, involvement of presence of high-level EU/national (political) representatives in events presenting EU-Rail's results. - Communication via social media channels might be expanded from providing general information about EU-Rail to also reporting on results of individual projects. - Creating an overall dissemination communication plan at JU level including the coordinated planning from the EU-Rail projects communication and dissemination activities.	Various channels were deployed for communication and dissemination of R&I results related to the JU's Programmes (see also Section 1.9). Cooperation with relevant stakeholders was ensured.
Delay or lack of expected inputs from the Flagship Projects into the continuous integration architecture activities under the System Pillar. This would also impact the topic on the Standardisation and TSI input plan and the respective specifications that would accompany the results of the plan. Eventually, effective implementation of EU-Rail Programme could be affected.	- Continuous alignment and interaction between the System Pillar and the Innovation Pillar, including through maturity checkpoints. - Involvement of the System Pillar steering group in the GAP phase. - Development of the ST IP to promote transparency on alignment.	Actions have been implemented on an ongoing basis. Adequate monitoring of the JU's Programmes was continuously ensured. Meetings of the System Pillar Steering Group and of the ED System and Innovation Programme Board were held.

In the months of October and November 2024, the JU performed a new risk assessment exercise with the aim of updating the elements related to risks considered relevant for 2025. Within this exercise, due account was taken of topical internal and external factors and developments having influence on JU's business. Attention was given also to the fraud risks. The updated EU-Rail risk register was provided to its parent Commission service – DG MOVE, and the JU also actively participated within the respective cluster of JUs and Agencies in the peer assessment/review of most relevant risks steered by the EUAN Performance Development Network.

The risks identified in the above-mentioned risk assessment activities which require, due to their criticality, continuous attention and treatment of the Executive Director and, where relevant, of the Governing Board, are presented in the JU Work Programme 2024 and the follow-up outcomes regarding these risks will be presented in the 2024 CAAR.

Further to the risk assessments mentioned above, in Q4 2023, the IAS performed at EU-Rail their in-depth risk assessment which resulted in the establishment of their Strategic Internal Audit Plan 2024-2026 for the JU.

1. IMPLEMENTATION OF THE WORK PROGRAMME 2024

1.1. Research & Innovation activities/achievements: the S2R Programme

The S2R MAAP translated the S2R Master Plan into detailed, result-oriented R&I activities to be performed with the objective of delivering the S2R vision as from 2016 onwards.

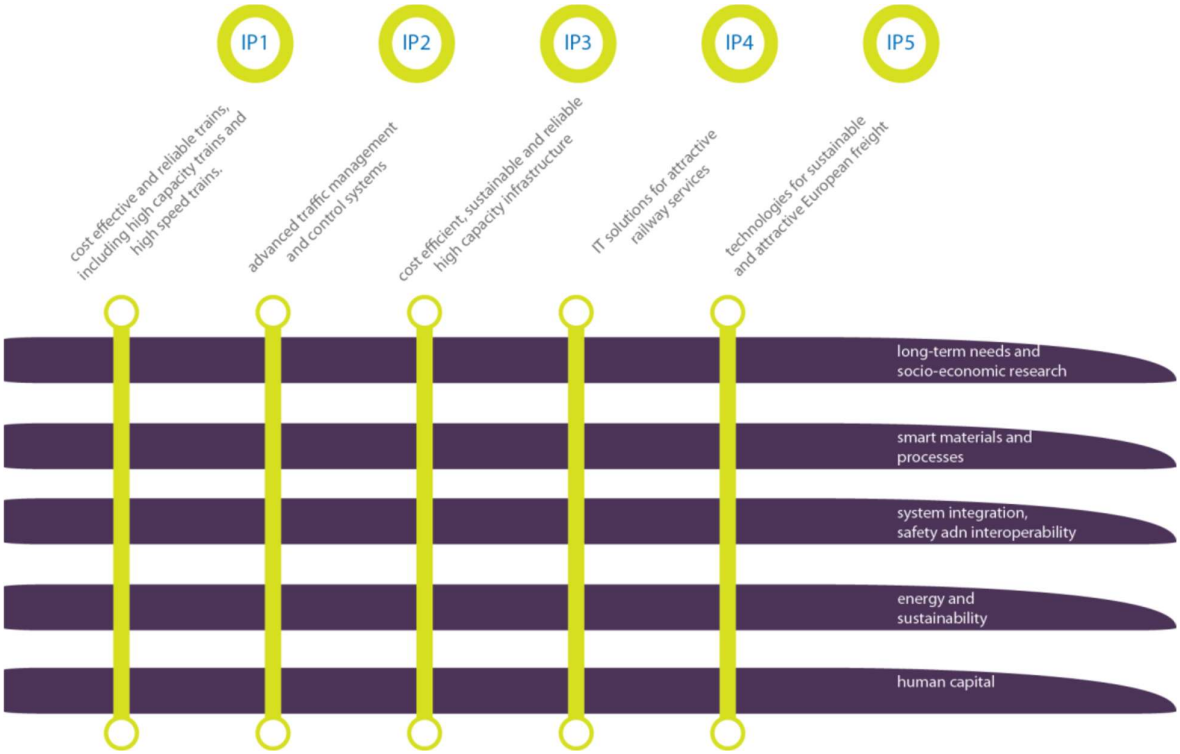
Addressing through R&I the challenges as they were detailed in the MAAP Executive View opened three opportunities for the railway:

- To become the backbone of current and future mobility concepts (e.g., mobility as a service-MaaS) and on-demand future logistics, through integrations with other modes in view of reaching a climate neutral European economy by 2050;
- To identify and establish new market segments for exploitation;
- To enhance the overall competitiveness of the industry, both in Europe and globally.

This is what the S2R Regulation tasked the JU to do when requesting it to manage all rail-focused research and innovation actions co-funded by the Union. Developing the Innovation Capabilities required a coordinated effort among different rail and non-rail stakeholders to drive innovation at all levels in Europe. The S2R Programme was designed to make a decisive contribution to delivering the essential knowledge and innovation that will provide the building blocks to develop the Innovation Capabilities.

The work conducted within the S2R Programme was structured around five asset-specific Innovation Programmes (IPs), covering the different structural (technical) and functional (process) sub-systems of the rail system. These five IPs are supported by work in five cross-cutting areas (CCA) covering themes that are of relevance to each of the projects and which address the interactions between the IPs and the different subsystems:

- IP1: Cost-efficient and Reliable Trains, including high-capacity trains and high-speed trains
- IP2: Advanced Traffic Management & Control Systems
- IP3: Cost-efficient, Sustainable and Reliable High-Capacity Infrastructure
- IP4: IT Solutions for Attractive Railway Services
- IP5: Technologies for Sustainable & Attractive European Freight.



S2R introduced additional IPx activities, R&I designed to look beyond currently planned technology applications (of the Technology Demonstrators) and how to integrate the S2R TDs with new operational concepts. IPx activities help to realise the global optimal approach for this System of Systems which is railway mobility, by starting to build a railway Functional System Architecture and a Conceptual Data Model (CDM).

In addition, in 2020, the JU set up the European DAC Delivery Programme, to bridge the gap towards future industrialization and deployment of a European DAC solution, building upon the work delivered in IP5 on DAC (see the following sections).

With a holistic approach, the S2R Programme ensured that interactions between the various IPs were adequately considered and managed, as technological developments in one part of the system could lead to changes in performance, or even create barriers, in other parts. In addition, cross cutting activities included research on long-term economic and societal trends such as customer needs and human capital and skills, which must be taken into account by the different IPs.

Different types of activities contribute to the Programme development, including:

- studies, fundamental and "blue-sky" research (TRL 0 – 2),
- scientific/applied research and laboratory demonstrations (TRL 3 – 6),
- operational demonstrations and innovation activities (TRL 6-7),
- other supporting activities.

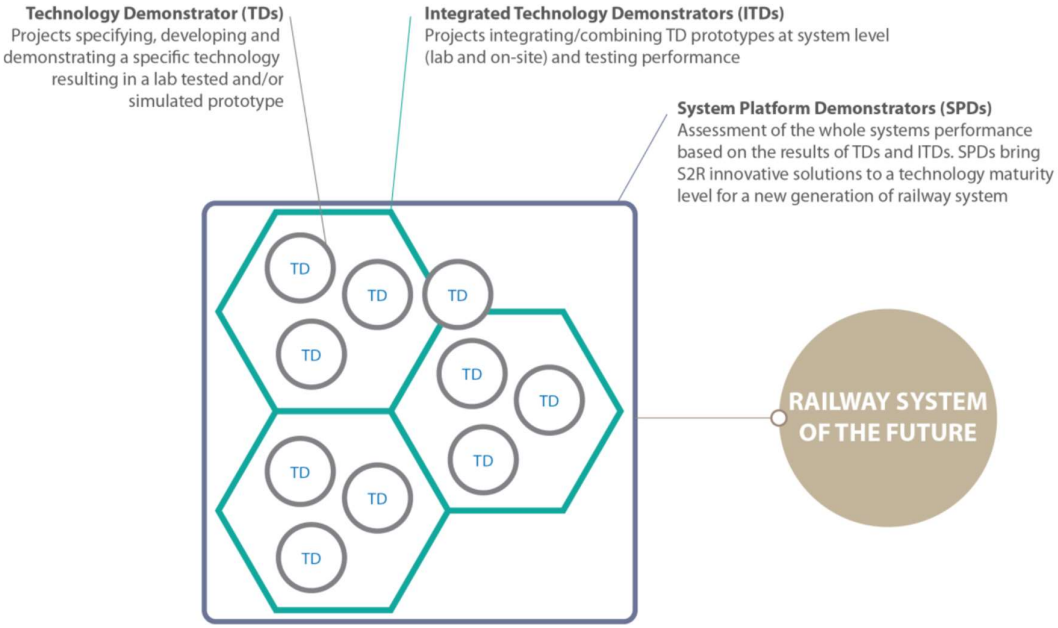
In addition to these activities that were co-funded by the JU and conducted within the scope of the S2R Programme, the former S2R Other Members were required to conduct Additional Activities with a view to leveraging the effect of the overall R&I. These Additional Activities were not eligible for financial support from the JU but had to contribute directly to the broader objectives set out in the S2R Master Plan.

Since 2020, the management of the Programme benefited also from the regular activities of the ED Programme Board. The ED Programme Board was established as a formal advisory support to the ED and has the role of:

- monitoring the progress of the Programme,
- identifying risks and opportunities and related mitigating actions,
- providing strategic guidance and making recommendations with regard to the management Programme,
- advising the Executive Director in solving issues escalated to his attention in accordance with the S2R Regulation on Programme implementation and propose a way forward,
- advising the Executive Director on the need to complement the Programme with specific expertise to be contracted,
- assisting and advising the Executive Director in any other matter of relevance.

The ED Programme Board proved to provide clear benefits to the overall Programme management, anticipating risks and opportunities, ensure higher integration and synergies, addressing issues to avoid negative impact on the expected deliverables.

The practical demonstration of S2R R&I activities is carried out using a combination of single technology demonstrators (TDs), integrated technology demonstrators (ITDs and resulting into the Innovation Capabilities) and theoretical system platform demonstrators (SPDs).



During 2024, there was a contractual closing of all H2020/S2R project activities.

1.2. Research & Innovation activities/achievements: the EU-Rail Programme

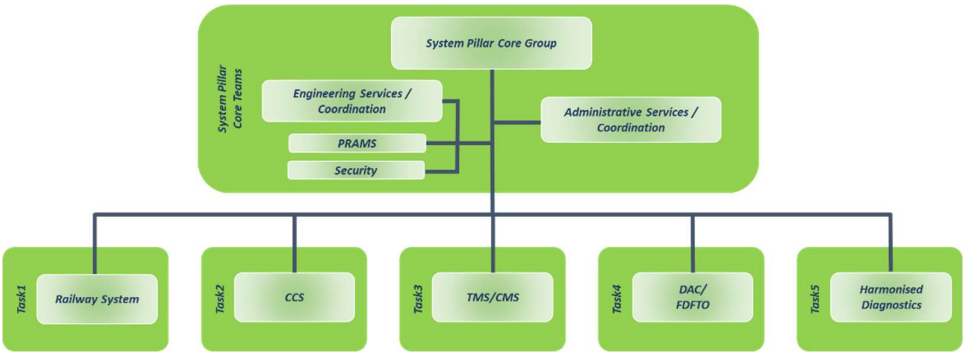
1.2.1. System Pillar

Organisation structure

The governance structure was set in 2022, with the System Pillar Core Group, under the supervision of the EU-Rail Executive Director and/or his delegated Head(s) of Units, leading the day-to-day work of the delivery of the System Pillar through the Tasks and with the support of Engineering and Administrative support services. It manages progress of and collaboration between the Tasks.

Progress and results achieved in 2024 from the SP governance and organization point of view:

- The standardised system of systems approach has been updated in the form of a new version of the System Engineering Management Plan (SEMP), the Version 3, which is an enhancement of SEMP V2.
- The first version of the Standardisation and TSI Input Plan (STIP) has been approved and published. The STIP is intended to coordinate the enhancements of the TSIs and the Commission standardisation request.
- Several activities related to the process for interaction of the System Pillar and Innovation Pillar have been carried out, like: Cooperation and a coordination between Task 2 and FPs 1 to 6 (specially with FP2 in ATO, MB and ASTP topics), shared interest topics between Task 3 and FP1, alignment of Task 4 and FP5.
- Upgrade of the special topic project Harmonised European Railways Diagnostics (HERD) to a Task status: Task 5 HERD, aimed to harmonize the exchange of diagnostic data at European level, with the target to ease the railway sector development and avoid blocks in business cases, in particular related to the maintenance activities of the railway system.
- Publication of the EU-RAIL System Pillar CCS/TMS data model, aimed to align the data structures that are to be used on the relevant interfaces of the CCS systems based on radio-based ETCS, in order to support the development and harmonisation of approach of the future development of those systems.



Together with the SP Core Group, the other SP horizontal teams are the Engineering Services / Coordination Team and the Administrative Services/Coordination Team.

The System Pillar Engineering Services / Coordination Team consist in:

- Engineering Environment Team: includes methods & tools definition and training for the whole System Pillar, monitoring of formal quality and allocation of work items and the consistency, traceability and integrity of the specification, active support to ensure quality and efficiency in the work of Tasks and Domains.
- Standardisation and TSI Input planning: structured along the catalogue of processes and interfaces/systems - describes the process of collecting and assessing IP and SP input to the harmonisation channels including regulation (TSI), standardisation (CEN/CENELC, ETSI) and System Pillar Industrial standards (SP documents).
- Performance, Reliability, Availability, Maintainability and Safety (PRAMS): Coordination on the PRAMS requirements.
- Security: Coordination of the Security requirements.

The System Pillar Administrative Services / Coordination Team consist in:

- Programme (Management) Office: Support all the activities of the System Pillar, including management of:
    - Progress
    - Quality
    - Resources and administration

- Communication

- Economic Analysis: economic analysis supporting the activities of the System Pillar (e.g. cost-benefit, enhancement change request, specific business cases, etc.).

Deliverables

The System Pillar Tasks and domains are:

- Task 1: Railway System
- Task 2: CCS, structured into:
  - The cross-cutting domain teams (comprising Operational Design, Architecture and Release Coordination and Migration and Roadmap).
  - The CCS System Design Teams (comprising Traffic control and supervision, Trackside assets control & supervision, Train control and supervision, Transversal CCS component, Field force CCS application, Communication team, Computing environment).
- Task 3: CMS/TMS
- Task 4: DAC/FDFTO System design
- Specific Topic Projects:
  - Harmonised diagnostics.
  - EGNOS for Rail. In the following sections more information about the organisation structure bodies is detailed, together with their outcomes and activities progress during 2024.

Engineering Environment Team

The Engineering Environment team (previously Central Modelling Services) includes methods definition (System Engineering Management Plan (SEMP)) and tools provision and training (Polarion, Capella, SysML specification environment) for the whole System Pillar. The Engineering Environment team monitors the formal quality of the work items, their correct allocation to the tasks and domains, and the consistency, traceability and integrity of the specification.

Progress and results achieved in 2024:

- The new version 3 of the System Engineering Management Plan (SEMP) has been developed, which includes the configuration and quality management plan, and the update of the existing annexes.
- The Requirements management has been updated with a clear traceability concept between System Pillar deliverables, requirement types and architecture concepts.
- Work on the remit deliverable related to "SP meta data" has been carried out, with the publishing of the first complete and consistent SP Glossary (incl. terms from European legislation), including guidelines for glossary and references usage.
- Within the activities related to remit deliverable of "Specification and model integration, quality assurance & import integration", during 2024 the QMP has been developed, as well as the unique reference architecture model in Capella.
- Tool support has been being provided during 2024, as needed for access management, as well as configuration improvements (e.g. update of documents lifecycle). This support activity also includes test and setup of API bridge between Capella and Polarion.

System Engineering Management Plan (SEMP)

The SEMP defines the workflow rules and arrangements, methods, and tool usage for all specification related activities in the System Pillar.

It is essential that all SP tasks and domains, and linked work, follow the SEMP processes to enable the large and dispersed group of people working within the System Pillar to speak the same language and follow common processes.

SEMP V3 has been elaborated during 2024 as an enhancement of SEMP V2 based on the remit of the specific contract 2.3.

The main updates are:

- The main document is structured according to ISO 15288 standard, which defines the general system lifecycle processes. SP SEMP tailors some of these processes to provide comprehensive processes for requirement management and architecture design in SP.
- Some appendices were combined in one consolidated document (MBSE handbook contains architecture design process and modelling rules)
- Requirement management plan contains a clear traceability concept between System Pillar deliverables, requirement types and architecture concepts.
- New appendices for quality and configuration management
- Guidelines for glossary and references usages
- Specialized engineering activities, such as PRAMS, Security and V&V guidance are also referenced in SEMP.

PRAMS

The PRAMS team is in charge to define the strategy, policies, methods, and principles to be followed by the other Tasks and Domains during the design activities as well as to coach and support implementation. PRAMS team do not produce PRAMS Analysis, Hazard and Risk Analysis, for system components or system parts; these activities are delegated to the related Domain that have to include members with PRAMS skills. The PRAMS Functional team is in place to have a proper coordination and synchronization.

Progress and results achieved in 2024:

- An advanced draft of the remit deliverable "Analysis of RAM Performance to reach overall Performance Targets" has been provided.
- A preliminary draft of the remit deliverable "Refinement of CBM RAMS rules" has been produced, with a small set of CBM rules under approval status during 2024.
- Deliverables regarding the "Update of the System Concept and PRAMS plan" has been elaborated during 2024.
- The remit deliverable "CENELEC changes proposal for harmonisation and modular approaches" has been provided in the form of STIP input from PRAMS.
- Regarding the remit deliverable "Coaching of PRAMS experts throughout ERJU SP and IP to follow the Safety Guideline and assure PRAMS requirements implementation", periodical (weekly) coaching has been provided during 2024, depending on RAMS experts available in other domains and availability of tools to perform safety analyses.
- A draft for the ERHD and Risk Assessment Template has been produced within the remit deliverable "Processes for Hazard and Risk Analysis and harmonized hazard lists for Operation and System level".
- Regarding the remit deliverable "Refinement of Performance KPIs and definition of Performance Targets for a modular railway architecture", the work will be continued taking into account feedback from the sector.

Security

Security requirements are coordinated centrally by the Security team. This includes top-level design and assurance of the security strategies and requirement implementation in the System Pillar Tasks and the specification of the subsystems for monitoring and the system control access.

Progress and results achieved in 2024:

- A draft (version 2) of the guidelines for implementing cybersecurity in rail were published, aimed to help in the railway specific implementation of general cybersecurity principles.
- Drafts of the following documents have been produced:
    - Shared Cybersecurity Services Specification: This specification defines the standard security interfaces (SSI) to the Shared Cybersecurity Services (SCS) and proposes the interfaces from SCS to the Enterprise Security Services (ESS) for the following services: STS, PKI, IAM, NAC, LOG, UAS, BKP, DNS.
    - Secure Component Specification: This document is a Cybersecurity Requirements Specification (CRS) that focuses on protection against threats and compliance with various standards. It aims to harmonize security measures across the market, minimizing deviations.
    - Secure Communication Specification: This specification is a Functional Interface Specification (FIS) for the security layer of Secure Components required for interoperability.
    - Security Program Requirements: This document outlines the security requirements for railways and suppliers, supporting the technical implementation and life-cycle management of security systems. It provides guidance for decisions needed before specification, tender, or implementation processes.
- Within the scope of the remit part of "Cooperation with System Pillar Domains and Innovation Pillar for continuous support of the integration of the security requirements", during 2024 active participation in SD-group meetings has taken place, and presentations status of Security draft documents have been carried out. The Security team has identified migration as an important topic to work on during this participation.

Task 1: EU Railway System

The main ambition for the Task 1 System Levels is to get a list of the needed and important improvements in selected interaction processes (business, technical and operational) (for a better "to be" architecture). A preliminary analysis should highlight differences in the selected interaction processes between countries represented in Task 1 to assess migration issues. For prioritized capabilities, full operational analysis and system analysis should be finalized using the SEMP.

Progress and results achieved in 2024:

- Energy report on energy saving measures has been elaborated (version 14 issued on March 2024). The report collects and assesses energy saving approaches in all relevant subsystems of the railway sector. This report contains a catalogue of solutions that have been trialled or used in the European rail sector, with a specific part for rail research programmes. The purpose of the report is to collaboratively share knowledge on energy saving with recommendations on how to support the accelerated deployment of these solutions.
- Delivery of the remit deliverable "As is (AI) Operational Architecture on the prioritized capabilities reflecting the differences between the countries"
- Reached conclusion of To-Be architecture of «Manage Energy» and «Operate Train» capabilities within the remit deliverable "04-Operational analysis of to be (TB) architecture. Setup the sectorial discussion in Polarion"

Task 2: CCS

Task 2 consists in developing the operational concept(s) and functional system architecture for a genuine integrated European CCS system, supported by a model-based systems architecting & 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 in Domain teams for cross-cutting activities and (Sub-)System Design activities that need to be managed and coordinated:

- 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 & Supervision Team
  - The Train Control and Supervision Team
  - The Transversal CCS Components Team
  - The Computing Environment Team

Progress and results achieved in 2024:

- Operational design Domain:
  - Collected operational requirements from the sector (RU, IM), derived from the CBO.
  - Concept capabilities finalized for 32 capabilities, including GoA2.
  - Preliminary operational risk analysis based on deliverable 2 – Risk Identification completed, with the Hazard Identification methodology agreed with PRAMS domain.
  - Within remit deliverable "Contribute to the clarification Task of the T2MIG team concerning the need of special lineside signals", the analysis of the topic has been issued to Migration domain in March 2024.
- Architecture Domain:
  - Coordination plans (meetings definitions) have been set up for ATO, ASTP and Interface catalogue, including the definition of the ATO mirror group.
  - First inputs for the Standardization and TSI Input Plan V1 have been provided in November 2024.
- Migration Domain:
  - Delivery of the remit deliverable "CCS features packages indivisible for deployment"
  - Input for STIP have been provided.
  - Delivery of the remit deliverable "Special trackside signals"
- Traffic CS Domain:
  - First input related to "Update of Standardization & TSI Input plan for Traffic CS topics" has been provided.
- Train CS Domain
  - Remit deliverable "Train CS logical architecture" finalised (initial Baseline 01)
  - Delivery of the remit deliverable "Update and more precisely specify Train CS System capabilities".
  - First alignment with PRAMS on the remit deliverable "Specification for Authorization, Integration and Upgradability of modular train CS system including train interface".
  - Detailed Train CS work has been performed with closed collaboration of the OCORA members within the remit deliverable "CCS Onboard Definition (Replacement of CCS Onboard relevant OCORA Topics)"
  - Within the activities associated to remit deliverable "Update of Standardisation & TSI Input plan for train CS topics", it was given support to Core Group for STIP v1.0, and the review of the STIP has been performed.

- Computing Environment Domain
    - Delivery of the remit deliverable "Computing Environment Operation concept - Operational Analysis"
- Trackside Asset CS Domain:
    - As part of the remit deliverable "Maintaining the specifications - update BL4R2", the EULYNX Baseline 4 Release 3 specification has been published jointly by EU-Rail SP / EULYNX. The primary focus of this release is to incorporate remaining feedback from the industry and reach a stable maturity level, fully integrated into the EU-Rail System Pillar
    - Review of the report on the need for light signals proposed by Task 2 Migration Domain, and agreement on the position portrayed in it
    - Regular use cases for Point and Level Crossing added on system layer as well as on logical layer, and Glossary integrated.
- Transversal Domain:
    - Development of the CCS/TMS data model. This data model, based on the extended ERA ontology, is a standardized framework aimed at enabling seamless data exchange across railway systems, and it specifies data structures that are critical for various railway functions such as engineering, asset management, operational plan, train protection, and automated train operations.
    - Delivery of the remit deliverables related to CCS/TMS diagnosis and configuration concepts.

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 2024:

- 5 variants for European TMS were proposed and analysed within the remit deliverable "Cross border TMS & CMS". This activity aims to improve the management of the European Railway system especially for cross border traffic, by determining the pros and cons of several (5) possible architectures models and their impact in different aspects.
- Several deliverables have been delivered related to System concept and system architecture.:
    - Draft Specification for Topology interface
    - Draft for TAF TAP TSI Interface
    - Draft for Legislative and economic issues
    - Draft Specification for Incident Management System
    - Logical architecture specification
- Delivery of the remit deliverable "System Definition"
- Delivery of the remit deliverable "Interface between TMS and Traffic Control and Supervision system", aimed to align the Traffic CS and TMS joint interface.

Task 4: Digital automated coupling (DAC), Full Digital Freight Train Operations (FTDFTO)

Task 4 is responsible to manage all cross-cutting activities related to DAC/FDFTO (e.g., regarding operational procedures, architecture and interfaces embedding the onboard system, developed by FP5, into the overall railway system), manage the input to the Standardisation and TSI Input Plan (STIP) for DAC/FTDFTO and supports FP5 regarding authorisation strategy.

Progress and results achieved in 2024:

- Work regarding the European operational rulebook has started during 2024. The rulebook work is based on the Operational Domain concepts and goes deeper, to specify the CCS system and respective rulebook.
- Also, during 2024 work has been developed for the remit deliverables "Operations Architecture related to FDFTO interfaces", "Possible further interfaces of DAC/FDFTO to the "outside" world" and "Central Instance Management of data & software".

Task 5: Harmonised diagnostics

The HERD team consists of representatives of the data user as well as of the data provider from supplier industry, infrastructure managers (IM), railway undertakings (RU), and vehicle keepers (VK). Strong alignment with the Innovation Pillar Flagship projects FP1, FP3 and FP5 as well as with the System Pillar Tasks 1, 2 and 4 is ensured by the team members.

This specific topic project was re-defined as Task 5 Harmonised European Railways Diagnostics (HERD) during 2024. This Domain is responsible to design a new standard procedure to harmonise European railway diagnostics. By this it will contribute to the creation of the Single European Railway Area (SERA).

Progress and results achieved in 2024:

- Two (2) use cases for harmonised diagnostics were analysed within the activities associated to remit deliverable "Detailed elaboration/development of the framework/architecture and applying framework to a concrete example of use cases, measuring systems and parameters; output: harmonized measuring methods and parameters. Detailed elaboration of the framework/architecture":
  - Track Side Vehicle Monitoring (WTMS) use case, which consists in monitoring the condition of railway vehicle wheels using WTMS (Wayside Train Monitoring Systems)
  - On-Board Track Monitoring use case, which consists in monitoring the track quality using on-board measuring devices (on special and commercial vehicles).

Specific topic projects:

EGNOS for Rail

Current existing EGNOS service has been developed according to aviation requirements. As these requirements are different from railway ones, this service cannot be used in rail safety related applications without additional activities to ensure the compliance with railway standards and to support safety evidence and guarantees.

For the successful adoption of the use of EGNOS within ERTMS framework, it is necessary that both the system/service and the service provision are defined, and where appropriate, properly introduced in the regulations and certified/authorised according to the European Rail regulatory framework.

Progress and results achieved in 2024:

- PRAMS Domain has contributed to document (ERA is main author) "Overall certification and authorization approach for introduction of EGNOS in ERTMS." This document addresses the certification and authorization aspects for the use of EGNOS, both for the system/service and the EGNOS Service Provider.

Standardization and TSI input Plan (STIP)

The System Pillar has developed a strategic Standardisation and TSI Input Plan V1.0 of the main changes to be introduced within TSIs (mainly CCS and OPE TSIs) and Commission standardisation request. This will include, inter alia, new functionalities and rules. This plan will also be made on the basis of migration considerations and alignment with Innovation Pillar flagship projects. Allowing for an agreed plan and timeline for the evolution of the CCS/TMS system, consistent with the agreed operational concept and system architecture and a clear picture of the role of the EU-RAIL in delivery, including the allocation of those elements that will be delivered by the Innovation Pillar, and the System Pillar.

Topics for harmonisation have been delivered by the members of EU-RAIL via the Task and Domains of the System Pillar as well as the Flagship Projects of the Innovation Pillar. In total, over 200 topics have been proposed, analysed by the System Pillar Core Group and EU-RAIL, and classified to allocate the topic to a manageable number of categories. The proposed categories are outlined in the table below..

Category for topic classification		
Category		**Description**
Main section		
C1	Operational harmonisation	Topics related to operational processes and rules
C2	Evolvability and maintainability	Topics aiming at enhanced compatibility between versions and easy maintainability
C3	TMS and CMS	Topics related to enhanced European TMS and CMS
C4	ATO GoA2	Topics related to ATO until GoA2
C5	ATO GoA3/4	Topics related to ATO until GoA3/4
C6	Remote supervision and control	RTO as application independent from ATO Goa3/4 (can come earlier) specific applications, e.g. shunting yards.
C7	ASTP	Topics related to enhanced odometry and localisation systems
C8	FDFTO	Topics related to enhanced freight traffic including DAC
C9	FRMCS	Topics related to new radio system
C10	Onboard	Topics related to CCS onboard systems
C11	Cybersecurity	Topics for cybersecurity in CCS systems
C12	Safety management	Topics related to safety in CCS
C13	PRAM	PRAM topics
C14	Trackside assets	Topics related to CCS trackside assets
C15	Traffic CS	Topics related to enhanced Traffic CS and interfaces to TMS/CMS
C16	Driving control, Adhesion management	Topics related to adhesion management and driving control
C17	Energy management and supply	Topics related to energy management and operational measures
C18	Bridge dynamics	Topics related to vehicle-bridge dynamical interaction
C19	Alternative propulsion, traction energy	Topics related to battery and hydrogen train
C20	TCMS	Topics related to TCMS
C21	Subsystem Components	Topics considering e.g. braking, environmental conditions etc.
C22	Reduction environmental impact	Topics considering noise, air quality and climate change
C23	Composite materials	Use of composite materials for lightweight design
C24	ETCS CR enhancement	ETCS CR enhancements from ERA assessed by the SP

Additional topics[20]		
C25	Digital asset management, data spaces and models	Topics related to data spaces, data models and asset engineering
C26	Digital Twin	Topics related to Digital twin modelling and digital register
C27	Virtual certification	Methods for virtual certification and implementation
C28	Zero-Onsite-Testing	Use of simulations and lab testing procedures
C29	Drones	Topics related to the use of drones in railway applications
C30	Field force applications	Topics related to field forces (maintenance staff and machines)
C31	Diagnosis, monitoring	Topics related to diagnosis, condition-based maintenance in railway applications

Categories for Harmonisation.[21]

Through the Standardisation and TSI Input Plan, the System Pillar has defined a clear and agreed plan for the evolution of the CCS/TMS system, the TSI enhancements, and standards, which will support interoperability, modular interchange ability, system integration ability, robustness, harmonisation and implementation of the SERA, and the role of EU-RAIL (both System Pillar and Innovation Pillar) in delivery.

The STIP does not include an explicit prioritisation of the topics. The implementation of the topics depends on the defined expected timeline, considering harmonisation needs and dependencies with related specification documents. The STIP key input will be obtained from the different tasks that conform the System Pillar and from the Flagship Projects in the Innovation Pillar, in order to obtain a cohesive multiannual plan.

The STIP document will be reviewed and updated in 2025, in order maintain the critical role supporting the harmonised introduction of improvements into the European rail system, supporting competitiveness interoperability, and safety.

System Pillar and Innovation Pillar interactions

In order to deliver a coherent output from EU-RAIL, the System Pillar and the Innovation Pillar will work together in the following way:

1. The System Pillar aims to provide the Innovation Pillar, where relevant, with a set of requirements aligned with the SP work, in order to ensure that research is targeted on commonly agreed and shared customer requirements and operational needs, compatible and aligned to the defined system architecture.
2. Reciprocally, the Innovation Pillar will impact the scope of the System Pillar where new technologies or processes mean that innovations can drive a change in approach, as well as delivering detailed specifications and requirements.
3. Accordingly, the SP considers results to be expected from the IP in its architectural works.

[20] The section "Additional Topics" includes topics with one or more of the following characteristics:

- Topics which do not yet have a defined time planning due to the early state and uncertainty in the development process.
- Topics which are very innovative and disruptive compared to established technical solutions. Acceptance and uptake by the sector might therefore require additional alignment and coordination.
- Topics for which the state of maturity does not allow a scheduled input to harmonisation channels in the short/medium term. Development and specification work is still ongoing, aiming at a higher maturity and the inclusion in one of the next STIP versions.

[21] Please consider that the list of topics may change/evolve as the project progress.

The main objectives of the IP-SP interaction are:

- Identify the main technical standardisation areas of collaboration between SP and IP, build in the projects the necessary details of the continuous process integration to reach together the EU-Rail outcomes that will achieve target system complying with the CBO.
- Include necessary provisions to achieve the Standardisation and TSI input plan together with all the necessary mature standards and regulation proposals.
- Revision that the inputs expected by the Flagship projects from the SP are foreseen to be achievable on time.

The current interactions between the SP domains and the IP FPs established during 2024 are in the table below:

Domain	Current Interactions with Innovation Pilar
PRAMS	On a voluntary basis, some members of IP WP8 - ATO Safety Analysis and PRAMS domain started to discuss how they could benefit from each other's results. It is really complicated to smoothly share content from IP to SP although both sides fully agree on the need and content
Security	IP representatives were invited and present during the Security onsite plenary meeting on May 22nd and 23rd 2024 (Frankfurt, Germany).
Task 2 CCS: Operational Harmonization	Interactions with R2DATO in relation to a compared analysis between SP OD and R2DATO ATO methodologies for operational scenarios specification. Additionally, OD specified obstacle detection concept on R2DATO request
Task 2 CCS: ARC	Involvement with FA2, specifically regarding ETCS (MB, ASTP, ATO). ARC is setting up coordination meetings with the IP related to ATO, ASTP and ETCS. ARC domain supporting ATO, Moving Block and ASTP coordination activities
Task 2 CCS: Train CS	Involvement with FA2, specifically regarding ASTP, ATO, and Ethernet CCS consist of network. Special exchange (Participation in workshops / detailed information and work share) with Transversal domain (Diagnostics, Configuration, ...) and PRAMS domain (Safety,…) Special topics according to ATO GoA2 (additional delivery object for phase 2.4) and tasks transfer from ARC and Migration Other interactions: • Exchange with Motional FA1 and Herd • SP-FA2(F2DADO) Plenary Meetings • Exchange with TASK4 (DAC) and Transversal (SD-3) topic: Remote Software Update concepts • Exchange OD, Topic: Remote transfer of Driver ID
Task 2 CCS: Traffic CS	Traffic CS has interacted with IP in the last two months on the following topics: • Exchange and commenting of ATO red flags. • Reuse of MB results under evaluation Additionally, there are few members of Traffic CS employed in some IP WP.

Task 2 CCS: Transversal Systems	Close cooperation with FA Transversal Technology (FP1). Cooperation in FP1 WP26 and WP27 and in FP2 in WP26, 27, 36, 45. TCCS – FP1: Exchange regarding engineering tool feedback for data model and validation/engineering rules established on regular basis via EU-RAIL MOTIONAL TT TCCS – FP2: Exchange of Data Model i.e. for WP27 "Digital Register" and the connected WP44/45 Moving Block Demonstrator. The Data Model is used for configuration and communication purposes (e.g. interface from/to TMS). Feedback is coming from the specification and demonstrator view. TCCS – FP3: Exchange of data model requirements, i.e. for infrastructure diagnostic-related use cases established on regular basis via EU-RAIL MOTIONAL TT. TCCS – FP4, 5 and 6: Exchange of data model requirements related use cases established on regular basis via EU-RAIL MOTIONAL TT.
Task 2 CCS: Computing Environment	Ad hoc meetings with WP26 to collaborate on the modular platform architecture topics including architecture, interfaces and Glossary. Share Operational Analysis deliverable and got the feedback
Task 3 TMS & CMS	Biweekly meetings with FP1 about topics of interest shared: TMS - CDAS/ATO information exchange, Cross border related topics- (with RNE active involvement), Review of requirements specifications and sharing of documents/specifications deemed relevant both teams' activities.
Task 4 DAC/FDFTO	Some experts in Task 4 are also part of FP5. In Task 4, they make sure our work is aligned, about the architecture topics, with the work and decisions made in FP5

1.2.2. Innovation Pillar

The Innovation Pillar is structured in 7 Flagship Areas leading to large scale demonstration as defined in the SBA, complemented by Transversal Topics which ensure the engineering integration of the Programme.

In 2024, the Flagship Projects responsible for undertaking the initial implementation of these Flagship Areas continued their activities. On the basis of the preparatory work done in 2023, all projects have continued working on use cases, requirements and development of specifications, as preparation for future prototype development ahead of testing in the second of these projects (foreseen from 2025 onwards). All FPs have also continued collaborating among themselves, as well as with the EU-RAIL System Pillar.

Flagship Area 1 (FA1): Network management planning and control & Mobility Management in a multimodal environment

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

FP1-MOTIONAL

FP1-MOTIONAL is the first project in the Flagship Area 1 which started on 1 December 2022. This project paves 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 multi0modal transport system for passenger and freight.

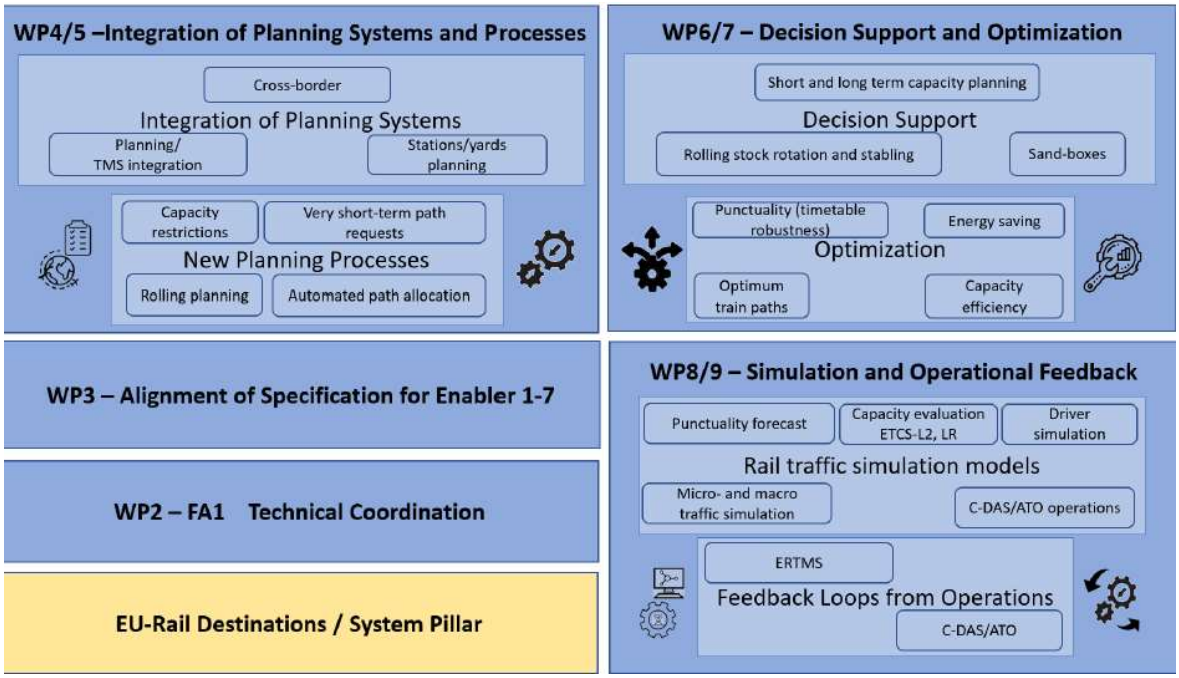
FP1 MOTIONAL is being delivered in two Work Streams (WS): WS1 for rail services Planning (WS1.1) and Operations (WS1.2) at the European level, as well as multi-modal door-to-door rail integration (WS1.3), and WS2 for digital enablers solutions (Transversal Topics) across all EU-Rail destinations.

Workstream 1 has three main sub-streams as explained below.

WS1.1: Capacity Management (rail services planning)

The main objective of Workstream 1.1 (WS1.1) is to investigate solutions to improve the short-term and long-term rail services planning at the European level, covering the following main areas (see figure below):

- Integration of planning systems and new planning processes;
- Planning decision support and optimization;
- Simulation models and operational feedback loops.



Progress and results achieved in 2024:

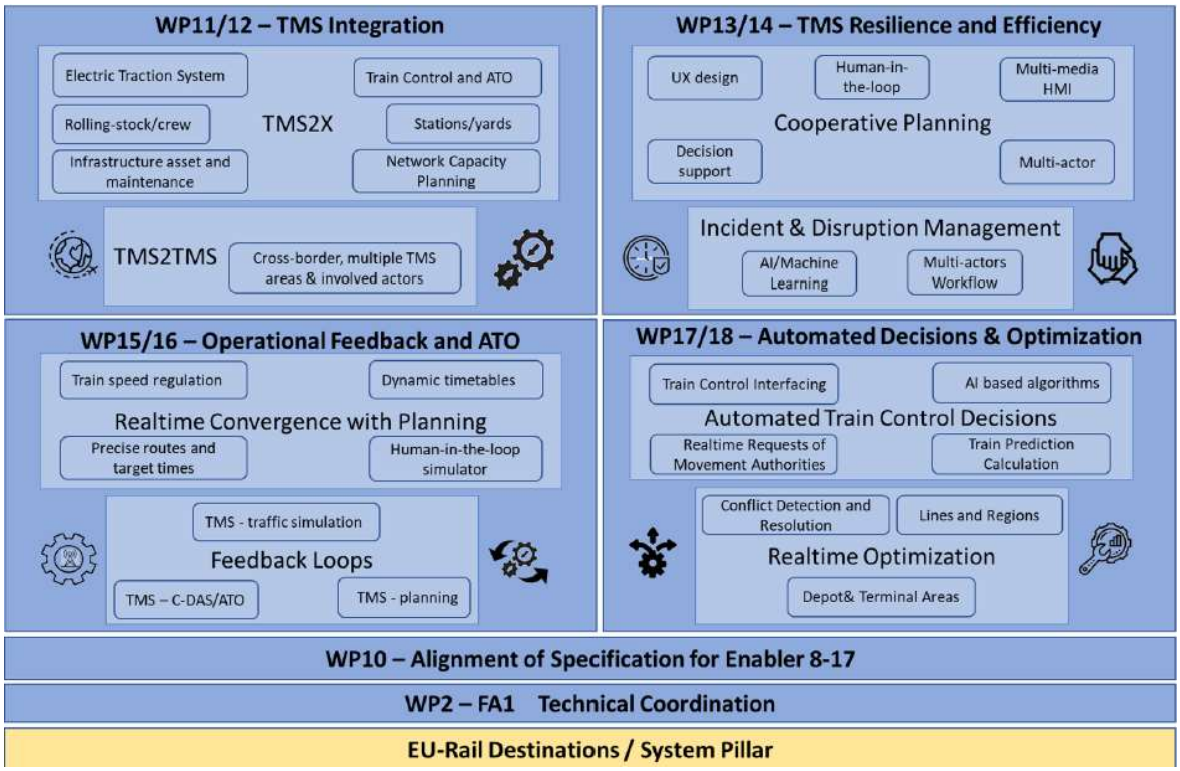
- Development of the design, high-level requirements and use cases for the integration of planning systems and processes explored by the project including: cross-border planning; use of rolling stock planning and Time Table redesign (TTR) for improved capacity planning; integration of TMS with yard and station capacity planning;
- Development and implementation of algorithms required for the use cases related to long-term and short-term timetabling and rolling stock planning, train paths optimisation, decision support in case of modified train paths, on-time running and new planning and operational processes using feedback loops from European Train Control System Hybrid Train Detection (ETCS HTD), Automatic Train Operation (ATO) and C-DAS.

Workstream 1.2: Traffic Management (operations)

The main objective of Workstream 1.2 (WS1.2) is to provide solutions for a more dynamic rail network and traffic management at European scale allowing agile, borderless and mixed-traffic operations based on a harmonised functional system architecture (see figure below):

- Integration of TMS and processes including cross-border traffic management
- Improved resilience and efficiency of disruption management

- Linking TMS to ATO / C-DAS for optimised operations
- Automated decisions and decision support for traffic management optimization



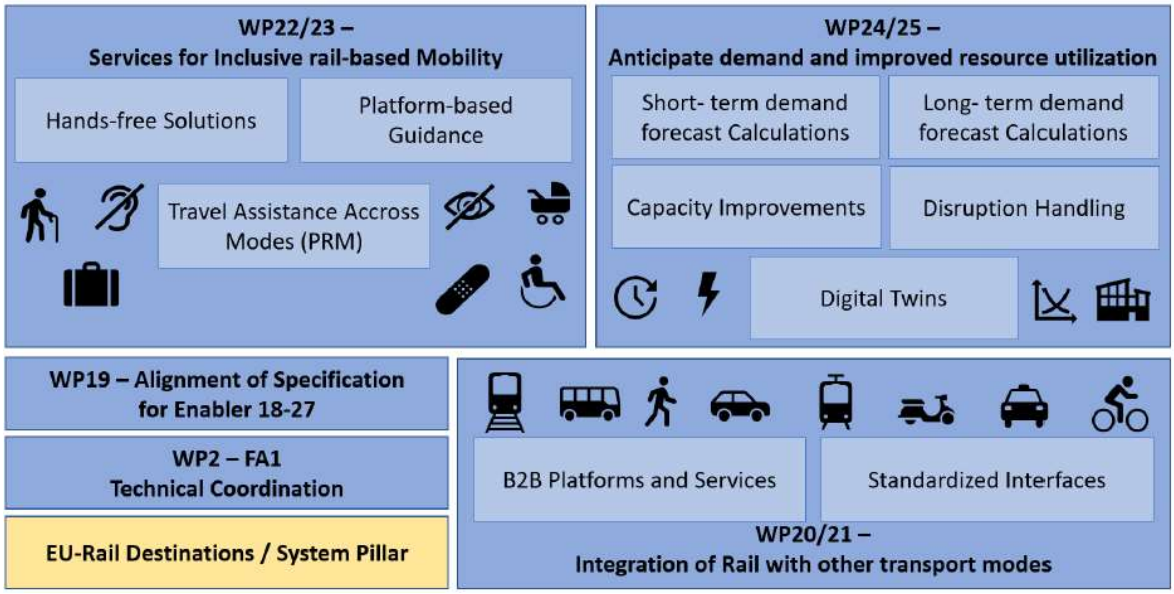
Progress and results achieved in 2024:

- Development of specifications for 9 demonstrations with a total of 31 detailed use cases for topics related to Real-time TMS connections and involved actors, Modelling and decision support for cross-border traffic management, Integration of TMS with: yard management system and processes; station management system and processes; energy management (Electric Traction System);and real-time crew / rolling stock dispatching.
- Finalisation of the Validation process for the developed components/functions of the relevant TMS demonstrations and use cases mentioned above.
- Development of prototypes and successful TRL4 validation tests for 4 demonstrations covering: decision support for disruption management; providing inputs to the planning service to support optimal decisions related to the railway infrastructure; and Human Machine Interface (HMI) for TMS based on User Experience (UX) Design and user input.
- Development of specifications, algorithms and TRL4 validation for 9 demonstrators including 13 Use Cases for topics covering real-time convergence between planning & feedback loop from operations and TMS speed regulation of trains, achieving optimised operations by linking the TMS with ATO in line with ERA vocabulary and the CCS/TMS data model developed by the System Pillar.

Workstream 1.3: Integration of rail traffic with door-to-door mobility

The main objective of Workstream 1.3 (WS1.3) is to investigate solutions for the multi-modal rail integration to improve door-to-door mobility (see figure below):

- Integration of Rail with other transport modes.
- Services for inclusive rail-based mobility
- Anticipate demand and improved resource utilization



Progress and results achieved in 2024:

- Development, implementation and TRL4 validation of various solutions for multi-modal rail integration solutions addressing ticket distribution, financial services, and disruption management. These solutions highlighted the importance of standardized interfaces like OJP, OSDM, SIRI-SX or NeTex to support seamless communication between different platforms.
- Development, implementation and TRL4 validation solutions for improvement travel quality and accessibility aiming to provide assistance, seamless validation and real-time guidance for passengers, especially those with reduced mobility (PRM). These solutions include: digital guidance displays (a 'Totem' and a 'Goboat') at train stations, mobile guidance through a MaaS app, seamless validation via facial recognition using UWB technology, and illuminated platform guidance for enhance passenger safety
- Development, implementation and successful TRL4 validation (manual testing) for solutions focusing on short-term and long-term demand forecast calculation using run time data and analytics based on a variety of sources aiming at optimising rail capacity in line with the demand, passenger occupancy and connection between services. These solutions also explored synergies between short term and long-term forecasts and a Digital Twins Human Machine Interface to provide a visual passenger support, especially in case of disruptions across different mobility modes.

Transversal Topic (TT) - Digital Enablers (FP1-MOTIONAL – WS2)

The main objective of the Transversal Topic (TT) is to support the operational processes and activities across all EU-Rail destinations by exploring solutions for digital enablers covering the following aspects:

- a Federated Rail Data Space to enable cyber secure rail data exchange;
- a Conceptual Data Model which will build on the ERA and Shift2Rail work on a standardised rail model and language;
- preparation and development of a Digital Twins (DT) environment, design tool-box and reusable, digital interoperable model units to enable the virtual representation of rail subsystems and allow the analysis of interoperability with other sub-systems.

As mentioned previously, the TT is implemented via the FP1-MOTIONAL (WS2).

TT.1 - Federated data space)

The objective is to deliver a trusted, reliable, cybersecure federated Rail Data Space sandbox environment that enables exchange and sharing of digital resources across Rail operators, Infrastructure Managers and Suppliers. It is envisaged that the Federated Rail Data space will be a component of the future Common

European Mobility Data Space and will be designed in compliance with the principles of the European Data Strategy, e.g., Data Sovereignty, Data level playing field, public-private Governance and Decentralized soft infrastructure.

Progress and results achieved in 2024::

- Delivery of a governance framework for the Rail Data Space**,** paving the way towards establishing the Governance Body in 2025 and onboarding more potential Rail Data Space participants outside of the EU-Rail funding members.
- Finalisation of user requirements collection process.
- Implementation of the extended data exchange methods to be used by the Federated Rail Data Space
- Commencement of deployment of connectors for the participants to Rail Data Space sandbox environment in preparation for the upcoming demonstrations.
- Development of specifications and first mock-up for the App-Store based on the user requirements.
- Defined and implemented a data model and interface for a so-called "Balast degradation and single-faults at switches" use-case to support the upcoming Federated rail data space demonstrations.
- Participation to Innotrans with a Federated Rail Data Space presentation and a demonstration of how this works (i.e. upload data via a broker service, and then allowing this data to be accessed and used via an App Store for a Digital System simulation as explained in TT.4 section below.
- Held two public presentations (Town Halls) where the scope, approach and progress of this work was presented aiming to encourage awareness and contribution from the industry.

TT.2 - Common Domain Ontology

The objective of this work package is to deliver a Conceptual Data Model (CDM) and expand the semantic dictionary building from the results of the Shift2Rail's LinX4Rail projects on a common standardised machine-readable model of the rail system domain. The CDM adheres to a semantic approach in line and in synergy with the orientations taken by the European Union Agency for Railways (ERA) (particularly around the Registers of Infrastructure) and by the European Commission. This work leverages industry standards and federates from specialist modelling initiatives, where present, to model the various domains of the rail system and requires an active collaboration with several initiatives and stakeholders (ERA, Joint Sector Group, buildingSMART International,…).

Progress and results achieved in 2024::

- Completed the CDM Topology, Positioning, Localization, Geometry and made updates to the Conceptual Data Model on the finalised modelling topics, demonstrating a bridge towards the IFC standards through an adapter (primarily around the concept of Ifc Alignment) and an evolution with greater compatibility towards the ERA ontology (GeoSPARQL, ...).
- Ongoing development of the CDM vocabulary for infrastructure and rolling stock digital representations and definition of an open standard data exchange format.
- Successfully demonstrated the RDF serialization for topology representations.
- Ongoing collection and analysis of Use cases from other Flagship Projects and System Pillar to identify new conceptual needs and relevant CDM topics (e.g., on digital modelling of rolling stock, use cases for maintenance), including the identification of data modelling requirements with possible impact / extension on the CDM.

TT.3 - Digital Assets Engineering

The objective of digital asset engineering is the harmonization of digital processes for the engineering design of physical railway assets (including CCS, Stations, etc.). This work package will enable the digitalisation of the end-to-end asset engineering processes. The outputs of this work package are classified as enabler 30 within FP1-MOTIONAL and include a specification of common domain models (Data model), software components (validation tool) and recommendations on application across Europe (Guidelines and Engineering rules) to foster the Single European Railway Area (SERA) vision.

Progress and results achieved in 2024::

- Ongoing literature review under the Deep Learning for Object Extraction task that evaluates the data extraction criteria for physical and logical assets.
- Planning and partially completion of Data acquisition for a specific region.
- Commenced the work on defining the output format and object specifications.
- Completed the first version of the engineering rules addressing the efficient and coherent data processing throughout the engineering process, also known as digital continuity.
- Planning activities for testing and optimization activities taking into account Building Information Modelling (BIM), co-simulation, and the progress towards automated testing.
- Updated and released version 1.0 of the CCS TMS Data Model ENG.SS026.
- Commenced the development of tools for schema extraction, serialization and mapping.
- Progressed the development of guidelines and standards for acquiring, updating, and developing BIM/AIM data and models which are crucial for the development and maintenance of Digital Twins. This work included the completion of the use case analysis related to other Flagship Projects.
- Significant progress on the preparation process for the upcoming demonstrations using industrialized tools. The BIM data development platform has reached its alpha version for web development, indicating a major milestone.
- Draft 'Guidelines and specifications for developing and maintaining Digital Twin' document.

TT.4 - Digital Twin support, development and run-time environment

The scope of this work package is to deliver a common Digital Twin design and simulation environment to allow the virtual representation of digital models able to imitate the behaviour of the physical railway system, its multiple heterogeneous subsystems and interactions during their lifetime. This environment is to be designed based on Digital Twin use cases provided by the FAs.

Progress and results achieved in 2024:

- Collection of use cases proposed by other Flagship Projects and selection of the ones to be used in the Digital Twin demonstrations based on 3 types of criteria: technical, strategic and interaction topics with other FPs. Examples of selected use cases include: Analysing the failure modes of point machines (FP3), Fault detection and diagnosis for the rail infrastructure (FP3), virtual certification for the rolling stock (FP1 and FP2), Pre-assessment of operational areas of ATO Set-ups (FP2), etc.
- Commenced the development of runtime environments for the selected demonstrations aiming at a consistent implementation of these environments to support the upcoming creation of modular, interoperable digital twins.
- Delivered Digital Twins demonstrations at InnoTrans 2024 event, showing how Digital Twins simulation model works with the Rail Data Space Sandbox. This demonstration has showed how the condition of the track can be simulated using the track data provided by the Infrastructure manager via an App store which is part of the Rail data Space Sandbox.
- Held two public presentations (Town Halls) where the scope, approach and progress of this work package was presented.

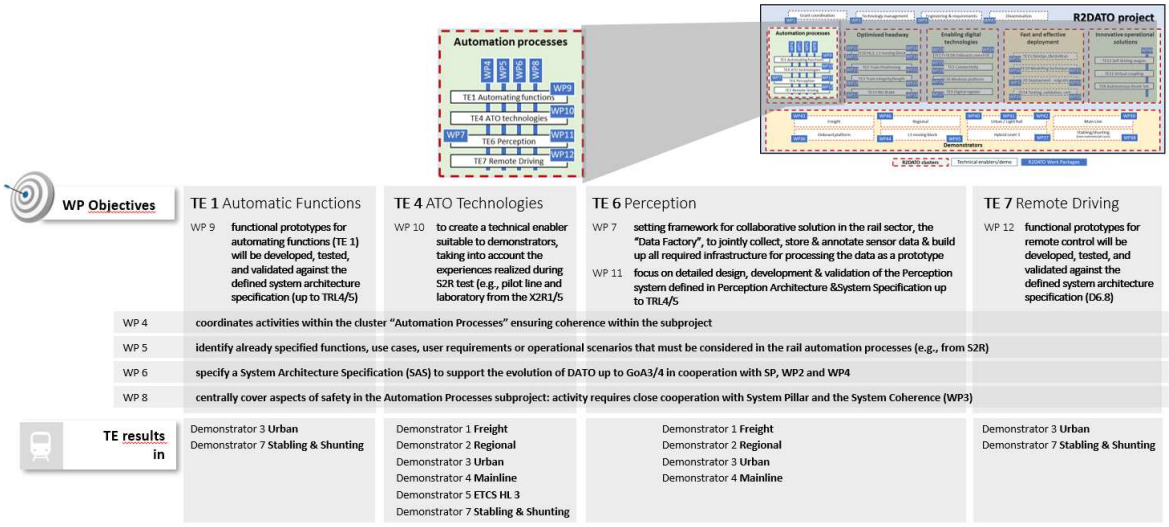
Flagship Area 2 (FA2): Digital & Automated up to Autonomous Train Operations

The objective of FA2 is to take the major opportunity offered by digitalization and automation of rail operation 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 (GoA) 4, 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 optimization of performance in line with the Traffic Management improvements developed in FA1. FA2 will aim 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 in 2024 implemented via Flagship Project 2 – R2DATO (FP2-R2DATO) launched in December 2022. In December 2024, FP2-MORANE-2, the EU-wide test campaign for the validation of FRMCS V2 was also officially kicked-off. Ramp-up of activities is expected in 2025.

Sub-Area 1: Automation processes



The *Automation Processes* Cluster (APC) covers the Technical Enablers (TEs) required to get to the target of achieving the automated to autonomous train operation in Europe. As automation is one of the main pillars of the future rail system, it means that the APC activities have strong links with other tasks and initiatives such as the System Pillar, Flagship projects 5 and 6 and the former Shift2Rail projects like TAURO, X2Rail-4 and CONNECTA.

Automation Processes, integrates four Technical Enablers (TE1 – Automating Functions, TE4 – ATO Technology, TE6 – Perception, including the data factory, and TE7 – Remote Driving) which represent core technologies required for the automatization of the railway operations.

These Technical Enablers are developed to the level of laboratory validated prototypes (TRL4/5) ready for demonstration (TRL6/7) in the *Demonstrators* Cluster.

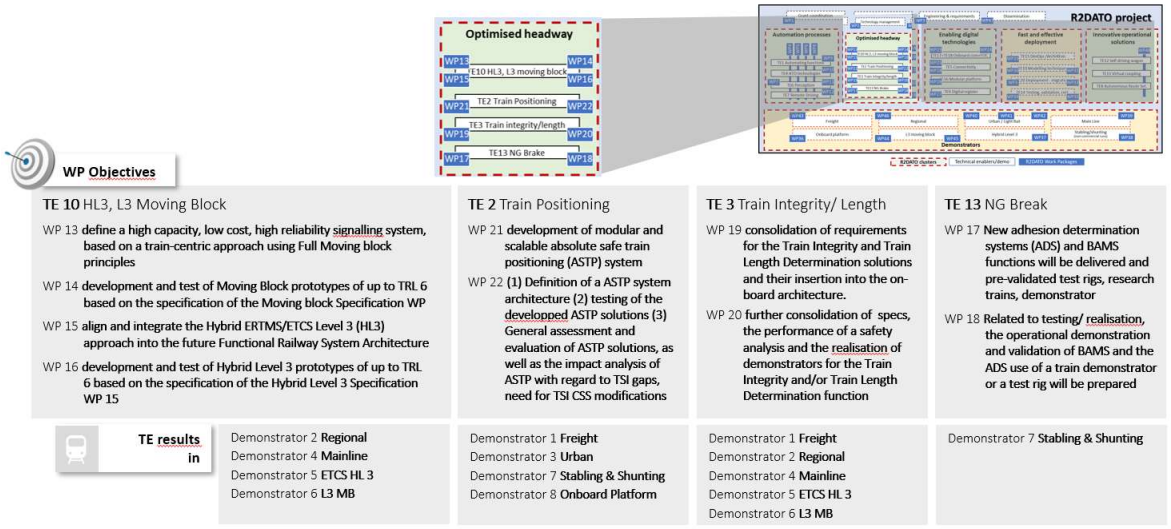
Progress and results achieved in 2024:

- Delivery and prioritization of the use cases for automation processes: these use cases being aligned and approved as foundation for the demonstrations in FP2-R2DATO as well as in FP5-TRANS4M-R and FP6-FutuRe. Use cases have been developed for automation functions (e.g. "*Wake-up" / Initialization and perform auto-tests/self-tests for normal operation in GoA 3&4*, *Prepare train unit for a mission – Select traction system automatically perception system remote driving)*, perception system (e.g. *On Track Detection System- On Line People Detection, React to obstacle, etc…).* Work in 2024 focused on developing the detailed technical specifications ahead of prototype development and testing, expected to take place in 2025 and 2026.

- Finalization of the "remote operation of tram" demonstrator in Oslo: this demonstrator was shown at InnoTrans 2024. This successful demonstration paves the way for further work and additional use cases for the use of remote driving in light rail environment but also for mainline railway operations. 30% increase on staff productive hours is estimated as a final impact.

- Integration of the Train Control Monitoring System (TCMS) in the baseline work of cluster [APC]. This includes work on Next Generation TCMS with a focus on supporting work for ATO and remote driving.

Sub-area 2: Optimised Headway



Optimized Headway's main expected outcome is the validation of prototypes ready to demonstrate the ERTMS game changers in different operational environments, with mixed radio based ETCS levels with Hybrid Level 3, ETCS L3 moving block, absolute train position, train integrity and train length management, as well as optimized and reproducible braking performance under low adhesion conditions. To achieve this, focus has been put on developing use cases and requirements in addition to work on architectural elements, in collaboration with the System Pillar. These steps are expected to lead to the development of building block prototypes and integrated demonstration.

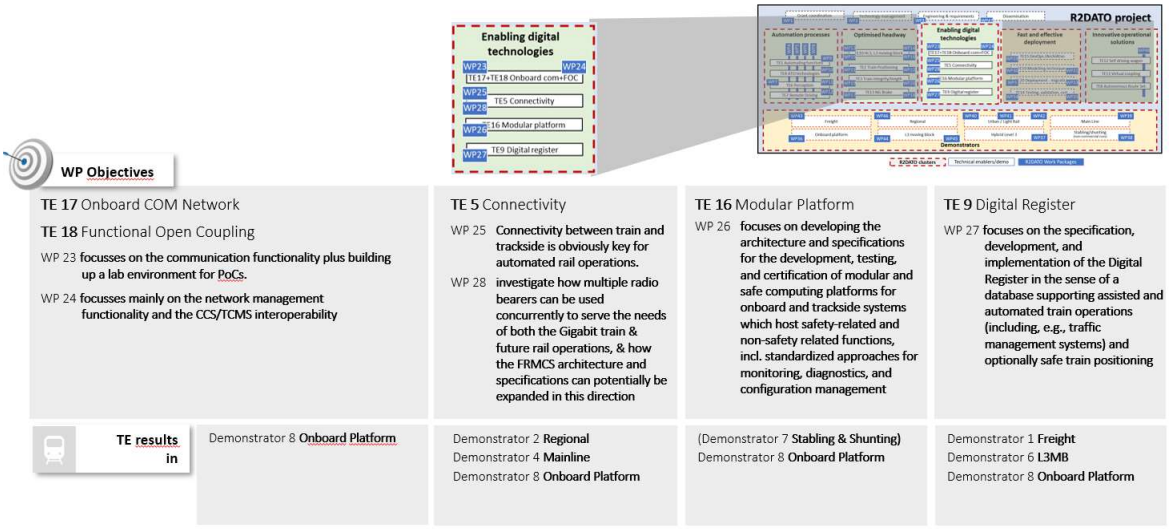
Progress and results achieved in 2024:

- The *Optimized Headway* Cluster (OHW) collected and aligned the use cases and operational requirements in the area of absolute-safe train positioning [ASTP]. The Advanced Safe Train Positioning solutions should provide more accurate position and speed, which will provide possibilities of optimising headway as well as energy train control assistance, allowing energy saving and densification of trains with less trackside equipment (e.g., reduction of the number of balises). ASTP "Advanced Safe Train Positioning" will reduce maintenance costs and improve availability within equivalent safety considerations. Localisation accuracy has been defined (+/- 5 meters) depending on the operational scenario (speed profile, headway need, etc…). A preliminary hazard analysis of the generic ASTP system was delivered and a report on common functional architecture and design was also provided.

- Furthermore, the integration of EUSPA & ESA for EGNOS activities (in the ad-hoc project *EGNOS4RAIL*) gained traction. A preliminary version of EGNOS for Rail system and service has been delivered by EUSPA and ESA. ESA provided railway dataset specific (for normal and degraded conditions) for use by FP2-R2DATO demonstrators.

- Hybrid Train Detection (HTD) and Moving Block aligned and successfully completed the specifications for the planned demonstrators. A HTD safety analysis was completed. In addition, the implementation to support the demonstrators has been initiated for Moving Block and HTD. A simulation environment was also defined to be used during the Moving Block demonstration. HTD is expected to contribute to an increase by 10% of the number of train on a line per hour.

Sub-area 3: Enabling digital technologies



The main and final results from *Digital Enabling Technologies* are further evolved specifications and validated prototypes related to connectivity (both for train-to-ground communication and onboard communications), modular IT platforms, and the Digital Register providing reliable interoperable and accessible infrastructure information as crucial enabler for safety related and non-safety related functions. These results are complemented by studies and specific concepts of how the modular connectivity, IT and data platforms can be efficiently integrated, certified, and driven toward acceptance. Same as for other specific outcomes of the project, the basis of the work will be to consolidate prior work, further derive the requirements of future rail operation toward connectivity, IT and data platforms, and define related platform architectures in collaboration with the System Pillar.

The connectivity, IT and data platform solutions developed in the Enabling Digital Technologies cluster start from very different maturity levels. Beyond the development and validation of the individual technologies, a key challenge is still to integrate these among each other, and for instance to demonstrate how connectivity protocol stacks and common service functions can be efficiently implemented side-by-side with railway applications, leveraging common hardware pools and for instance common orchestration approaches. The main focus will be to provide the future-proof connectivity, IT and data platforms required for the automation of rail operations. Increase the cost efficiency will be a main focus leveraging off-the-shelve IT solutions by decoupling the life cycles of railway applications and connectivity.

Progress and results achieved in 2024:

- The cluster has progressed on the technical enabler linked to the modular platform. The requirements, architecture and specifications of the final modular platform have been delivered. The analysis and concept work are expected to further contribute to EU-RAIL SP progress, supporting the domains in defining a suitable environment for modular platforms to be commissioned in the future. Modular platforms are feasible in the railway context. However, the complexity of a fully defined MPC (modular platform concept) for safety functions set limits to the depth of specification. The actual level of harmonization of a platform, to fulfill interchangeability target (and decoupling the lifecycles of software and hardware), is still under discussion. However, the delivered concept is a strong basis for further iteration.

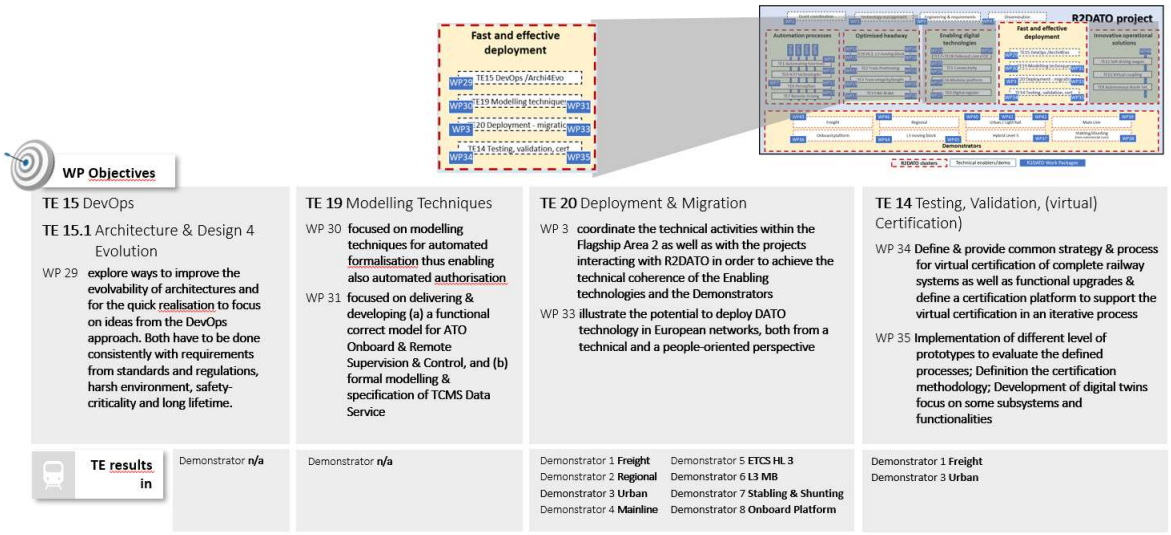
- Furthermore, the activities for Onboard communication resulted in the delivery of use cases and requirements for onboard communication network. Also, a list of solution candidates was completed. By providing proof-of concepts for solution space selection/exploration on communication functionality and basic services as well as a certification concept for the onboard communication network, the work on communication foundations and basic functionality ended in 2024. In 2025, the activities will focus on network management functionality, processes and overall integration.

- The connectivity development with a main focus on FRMCS was impacted by the delay in the specification of FRMCS. Preparation activities have continued and the implementation of the laboratory demonstrators have started. Antenna solutions were evaluated in a workshop together with antenna providers, however solutions were proven to be compliant with FRMCS V1

specifications. The project participated in the ETSI MCX plug test (interoperability tests to validate implementations on the basis of 3GPP specifications). The alignment with the FP2-MORANE-2 project, launched in December 2024, will continue in the first half of 2025.

- For the digital register activities, a taskforce was set-up. In full collaboration with the System Pillar, this task force completed the use cases and requirements on the digital register. The connection of the Digital Register with Moving Block has been set up in order to provide the data needed. The specification of the data model follows the specification provided by the SP and FP1-MOTIONAL.
- Connectivity Development with focus on ACS/Gigabit Train has evolved with respect to different use cases designed for the regional lines and with the design of a multi-connectivity platform. First analysis was done for the testing of the prototypes and agreement on a common approach reached.

Sub-area 4: Fast and effective deployment



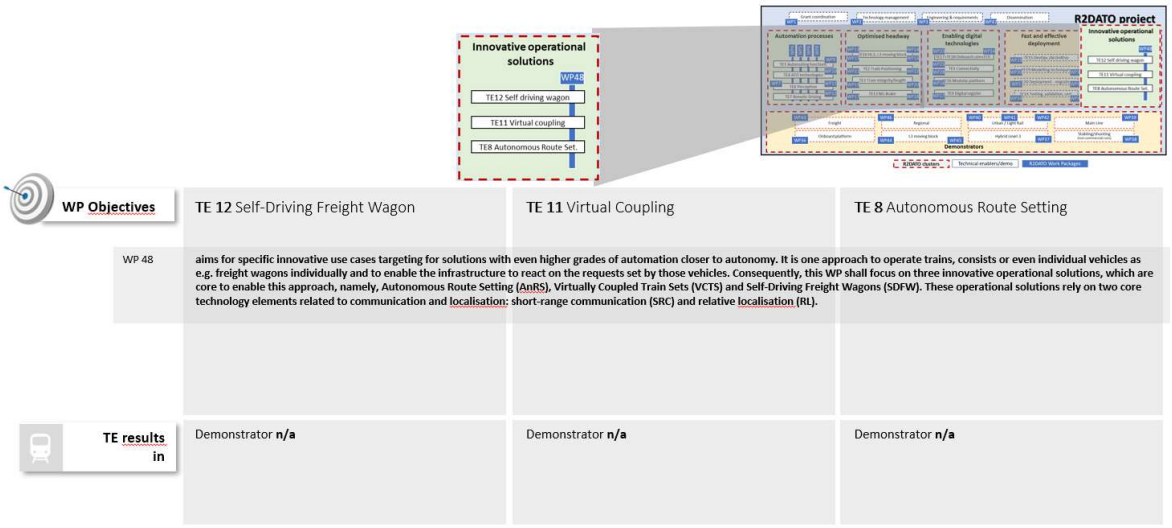
General objectives of the Sub-Area 4 - Fast and efficient Deployment

In order to allow fast and effective deployment, the various impacts of DATO shall be anticipated and analyzed. While the development and demonstration of technical enablers will allow to check feasibility and performance of technological solutions, there is also a need to quantify the benefits, and refine the concept and feasibility for the final application. This societal and logistic-oriented workstream will focus on human factors and operational aspects when preparing, migrating, and demonstrating the future potential for operations. Innovative new modelling techniques such as Formal Methods, DevOps and Architecture Design4Evolution, will contribute to this overall methodology to speed up the development process and secure fast and effective impacts.

Progress and results achieved in 2024:

- An outline of the business case has been completed. Several steps of analysis have been started to quantify the operational benefits analysis of ATO: capacity and impact simulation, analysis of potential infrastructure wear reduction, ATO Human factors Impact Assessment and Analysis. The activities are carried out in close collaboration with Next Generation brakes and FP1-MOTIONAL which will provide the simulation.
- For testing and validation, a common strategy and process for virtual certification of complete railway systems as well as functional upgrades is being defined. Furthermore, the requirements for a certification methodology were defined and approved. The activities ended in 2024 by providing a design for a test platform. In 2025, the focus will be put on the specification of analysis tools and the certification methodology approach for the SERA.
- DevOps and Architecture and Design4Evolution provided a Catalogue of architectural patterns for evolvability and DevOPS process building blocks.

Sub-area 5: Innovative operational solutions

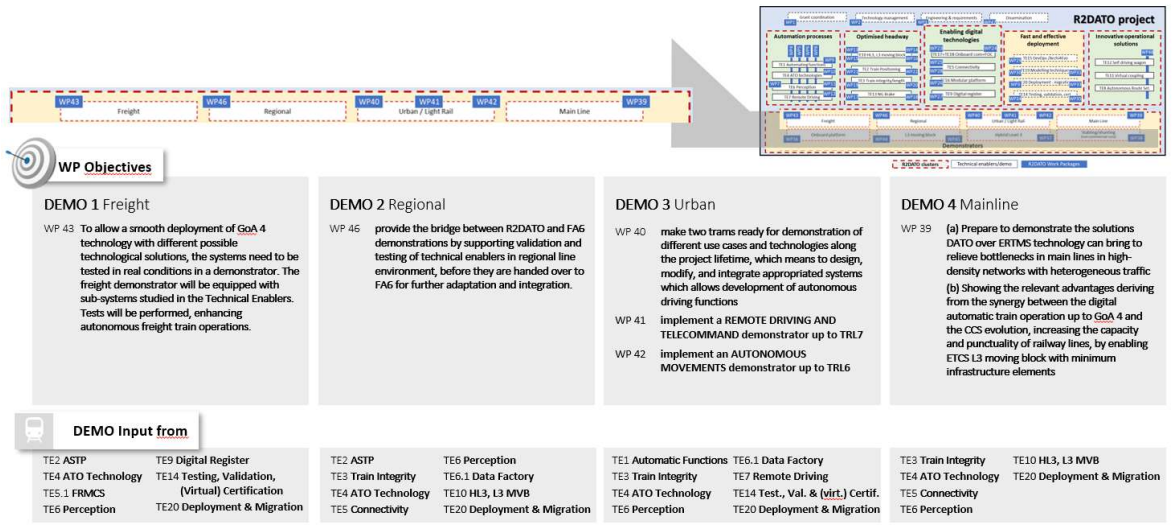


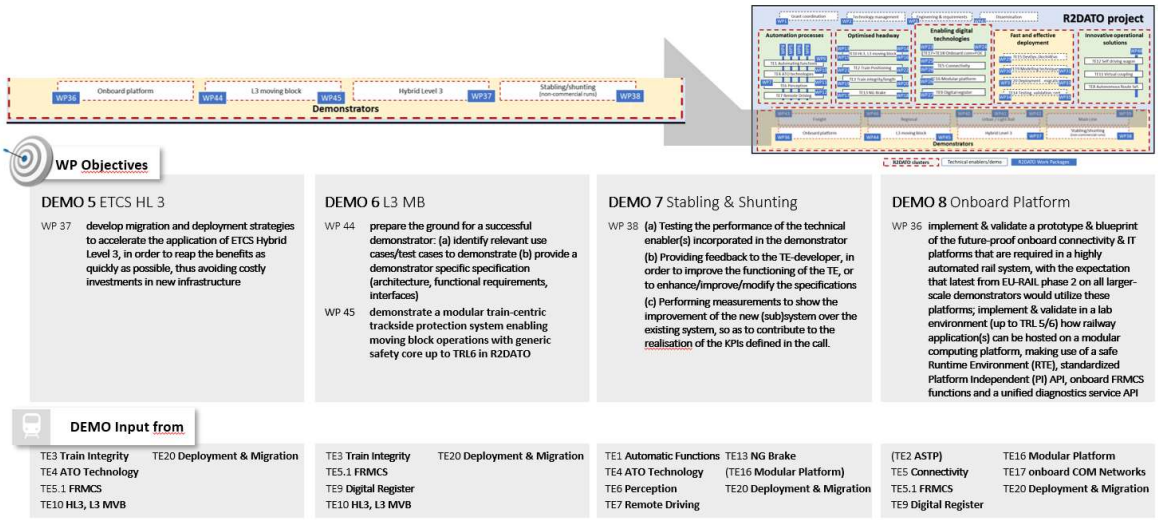
The aim of the cluster *Innovative Operational Solutions* is to identify, based on the definition of innovative concepts, specific use cases where a further innovation beyond the GoA4 could bring additional value. The foreseen innovative concepts include the Autonomous Route Setting (AnRS), that will realize the autonomous path allocation on a technical level and help increasing the capacity on the network, the Virtually Coupled Train Set (VCTS), that is required for the steady state of operating virtually coupled train sets and the Self Driving Freight Wagon, that will enable autonomous operations of single wagons. The technological element in focus will be short-range communication (SRC), in order to reduce latencies down to the minimum in a train-to-train communication and relative localization (RL) e.g. between two consists or vehicles, to ensure the shortest possible dynamic distance between them.

Progress and results achieved in 2024:

- Within cluster *"Innovative Operational Solution"* the use case list & concept for autonomous route setting [AnRS] was defined. In addition, the architecture and interfaces for the virtual coupled train set [VCTS] was agreed.
- Furthermore, a set of test cases was defined for the technology development of short-range communications [SCR] and relative localization [RL].

Sub-area 6: Demonstrators





The Demonstrator cluster main expected outcomes are the following:

- validation of the benefits of DATO technical enablers and;
- validation of DATO technologies for specific target implementations.

The demonstrators will be derived from one Technical Enabler (TE) or a combination of TEs, with the goal to demonstrate the targeted maturity level for the TE(s). Each demonstrator is set-up to verify specific technical enablers in a certain environment and for different use case(s). To effectively demonstrate each TE, a selection is made out of representative environments, which are related to the main use cases and deployment needs for the technology. The demonstrator will allow to validate the KPIs set at the inception of the programme, uses cases and functional needs and deployment and migration needs. Moreover, TEs can be used in specific demonstrations as support to validate other TEs. This process is shown in the figure above.

Depending on the required TRL, the demonstration will be performed either in a simulated/ lab environment, or in a controlled real-world environment. For most activities, a full system demonstrator at TRL7 is out of scope for this project phase 1. However, pre-deployment activities will be undertaken by demonstrating the performance of the system in a controlled environment and/or in a lab or simulated environment and preparing verification, validation, and certification evidence. These results can then be used as input during the full system level demonstration in the future phases of the EU-RAIL programme. First steps in the development of the new functions and technical enablers will be completed, leading to prototypes and/or validation in laboratory (TRL5) and field (TRL6). The project will also allow to progress towards modularization, and first validation of the next generation ATC system in close collaboration with the System Pillar.

Progress and results achieved in 2024:

- For the FP2 R2DATO *demonstrator [D6] moving block system [MBS]* the architecture to be demonstrated was agreed and a release plan set up covering 5 different releases for the demonstration. The solution is specified and implemented according to the different releases. The steps will be carried out in the digital test field of DB in Annaberg. The demonstration covers the Moving Block System, the Digital Register and the Plan Execution (PE), whereas PE is provided by FP1-MOTIONAL. A simulation environment has been set up and defined. This simulation environment will be installed on a test site of ÖBB.
- A *remote tram demonstrator [D3] urban* was completed and shown at InnoTrans 2024 (as explained in the cluster Automation process) In order to set up the demonstration several steps have been carried out during the year with the support of a Tram Operator in Norway. The goal is to improve and automate the depot of the tramway using remote driving. Experiences have been gained in several areas: operational aspects through involvement of the drivers, adaptation of the tram and on the technological side with respect to the defined use cases and requirements. Two on-site

demonstrations have been carried out: one in June to show to the FP2-R2DATO partners and one at the InnoTrans 2024, in Berlin.

- The *demonstrator [D8] onboard platform* user stories to be demonstrated have been agreed between the partners. They have been implemented, deployed and tested in a virtual development and test environment. In addition, the FRMCS related on board and infrastructure components have been provided.

Flagship Area 3 (FA3): 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.

Sub-Area 1: Wayside Monitoring and TMS link

The primary objective of Sub-Area 1 is to integrate predictive maintenance and intelligent asset management. Specifically, an Intelligent Asset Management System (IAMS) for wayside assets has been designed and is ready for deployment, with future validation planned in two different Use Cases in Italy and Spain. This system includes securely collecting, storing and analysing data from wayside assets, and sharing information with the Traffic Management System (TMS) regarding asset status and the detection of possible anomalies.

Progress and results achieved in 2024

- Significant progress was made in both design and deployment phases, alongside the initiation of testing and validation processes. This includes early data collection activities supporting the development of simulators and Digital Twins. Alignment activities with FA1 are ongoing, with the main objective of defining common methodologies and best practices regarding TMS and Decision Support System.

- Specific IAMS architecture for both Sub-Area 1 Use Cases was finalised, based on the general architecture defined in the early stage of the project, and will be developed and validated in 2025.
- The planning and implementation of most of the installations, including sensors on wayside assets like the Point machine and level crossing in the Spanish Use Case and the non-intrusive IXL monitoring system in the Italian Use case, allowed for the development of early demonstrators. Specifically, early data collection and analysis led to the creation of initial dashboards with monitoring and basic anomaly detection functionalities.
- In the Italian use case, the platform provides the operator the possibility to monitor useful statistics about train transits, speed and switch movements; additionally, the operator can set rules and automatic thresholds so that the platform can notify them if some anomalous behaviour is detected.
- In the Spanish use case, the operational data (voltages and currents) collected from the level crossing barriers has been analysed to develop a first model for anomaly detection that, based on laboratory data, already achieved a high level of accuracy in the identification of anomalous movement. A subset of these functionalities was displayed in November, during the FP3-IAM4RAIL Mid-Term Event.
- Finally, the Obstacle Detection System designed to monitor level crossings and alert the TMS in case of anomalies, has been tested in laboratory under various simulated conditions: the test performed included the simulation of fog, rain and the capability of the system to identify moving and fixed object in the area of interest. All tests have been successful and will be improved in the coming months to enhance the capability of the solution.

Sub-area 2: Rolling Stock Asset Management

Sub-area 2 is focused on rolling stock asset management addressing on-board and wayside technologies developing new monitoring and inspections systems. Data on asset health collected will be used to perform data analysis and to develop predictive algorithms to support decision and planning of interventions. This aspect is very crucial considering that railway operators in Europe face constant pressure to control operating costs while maintaining high levels of reliability and efficiency. Maintenance costs and increasing expectations present many challenges. The primary goal for any railway operator is to maintain their fleets

well, requiring regular inspections and repairs. To address these challenges, railway operators must shift from the old maintenance paradigm, based solely on preventive and corrective maintenance strategies, to a new one that integrates new strategies such as condition-based maintenance. To pave the way for this shift, a set of maintenance algorithms should be developed to enable the transition to the new paradigm.

Progress and results achieved in 2024

- Vision of future European Railway Checkpoints, in alignment with FP5 from a holistic point of view, has been further refined. This includes mapping of possible technologies for infrastructure assets and on-board systems related to checkpoints, as well as evaluating functional and operational objectives.

- Data acquisition technologies for on-board monitoring systems have been initiated, and the development of algorithms for anomaly detection for subsystems such as Bogie & Traction has successfully started. Innovative Bogie sensing technologies have been developed within Use Case 5.1 and tested on-bench, using a ALSTOM test facility in Ornans, France. These technologies were also tested with already pre-damaged or faulty and worn components, including the implementation of artificial defect. The main objective of the whole campaign was to optimise the economical way of monitoring the bogie, e.g. by increasing the number of components which could be monitored with each sensor. These technologies are now completing the overall portfolio of sensing technologies which were partially developed in former R&I projects like Shift2Rail. In second half of the project, starting in 2025, the most promising technologies will be used for on-track testing by using Intercity New Generation fleet in the Netherlands to improve accuracy and to finally reduce in-service failures.
- The definition of functionalities and requirements for the installation of wayside monitoring systems are ongoing. Moreover, significant progress was made in proving the safety of Condition-Based Maintenance (CBM). This involved developing a methodical, generic approach and validating its transferability. The methodical approach focused on creating a safety certification method for the CBM data path, which extends from the onboard telematics systems on locomotives to the maintenance systems in SAP. This method emphasized the importance of monitoring data quality and managing telematic devices effectively. Detailed steps and standardized procedures were established to ensure a comprehensive safety assessment and compliance with relevant standards. To validate the transferability of this approach, it was examined and demonstrated through two scenarios from different train operating companies. This process showcased the method's applicability and effectiveness across various operational contexts, confirming its robustness and providing insights into practical implementation. The process of creating the safety certificate could be shortened by 4 months compared to the first implementation of a safety certificate within DB Cargo.

Sub-area 3: Infrastructure Asset Management

Strategic railway infrastructure asset management, particularly in maintenance, is crucial for safety, asset longevity, and operational reliability. It enhances customer satisfaction, minimizes costs, ensures regulatory compliance, and contributes to a sustainable and efficient transportation system by optimizing resources and minimizing environmental impact.

Sub-area 3 addresses various aspects of infrastructure asset management through demonstration in 13 use cases, with two main objectives:

• Long term asset management: developing decision and support systems for asset management and life cycle costing optimization;

• Enhancement of asset management and infrastructure via new monitoring and inspection system. These systems integrate Big Data from on-field and on-board sources, facilitating information sharing across the supply chain and Traffic Management System.

Work Streams 2 and 4 focus on specific assets, while Work Stream 3 provides tools and data integration applicable across all streams. Work Stream 1 benefits from these innovations for long-term strategies, creating a cohesive IAM approach.

Progress and results achieved in 2024

- A suite of applications utilising diverse technologies to exploit the prototype platform's high-level architecture across use cases is under development. Interaction with FP4 has been initiated,

focusing on the use of optic fibre for railway infrastructure monitoring. Additionally, alignment with FP1 is being addressed, focusing on data sharing protocols and interfaces related to the infrastructure asset register.

- Regarding Work Stream 1, focusing on improving asset reliability and optimising life-cycle costs through the development of decision-support tools for long-term infrastructure maintenance, progress has been reported on the monitoring vehicle-track interactions using onboard sensors and machine learning, optimising maintenance schedules and analysing the Remaining Useful Life (RUL) of infrastructure, like bridges have . To enable RUL estimations of bridges a bridge in Norway has been successfully instrumented. The measurements will be used to estimate the bridge life consumption generated by the train operation. Future efforts will focus on completing simulations, refining maintenance strategies and integrating data for better planning. A tool for deriving an optimised data driven tamping schedule has been developed. The tamping scheduling problem was formulated as a mixed integer linear programming (MILP) model, considering the economic and structural dependencies of opportunistic maintenance. The objective function of the model includes tamping costs, fixed costs for occupied tamping windows, expenses from early tamping, and corrective tamping costs. Another achievement is the implementation of a feature for coordination of work on infrastructure, where maintenance, renewal, investment activities can be coordinated to serve optimization of production logistics, as well as to minimize utilization of track capacity. The feature has now been implemented in an existing maintenance management tool.
- Regarding Work Stream 2, advanced sensing and AI tools for track systems have been developed, enhancing fault detection and tools that allow prescriptive maintenance. Significant progress was made in developing intelligent railway sleepers using graphene-enhanced concrete, including laboratory experiments to determine the optimal graphene additional, with a prototype of the data collection environment installed and tested with initial data collections conducted and plans for its implementation in operational tracks and advanced data analytics. Among the prototypes for sensing, the Lindometer has been tested to evaluate and refine the assessment for defect detection in insulation rail joints and fasteners, with measurement campaigns already conducted. Axle Box Acceleration (ABA) measurements were conducted in Germany to enhance the prescriptive maintenance planning process, and in the Netherlands, the fusing of ABA with laser Doppler vibrometer signals was already conducted to obtain direct measurements of dynamic models of the track, which became an alternative to hammer tests. The key improvements in sensing give room to tailor maintenance works better, for instance, by allowing the monitoring of track, sleepers and loose fasteners with a very high level of details that facilitate the assessment of the degradation of components way before their failures. Demonstrations will continue in 2025, focusing on refining technologies, expanding field tests and enhancing predictive algorithms.
- Regarding Work Stream 3 that involves pilot sites for implementing multi-source data systems for short-term asset management, the data exchange processes to evaluate and validate these applications have started. Tangible result in 2024 of this work stream introduces the "reality model," a digital representation of actual field conditions overlaid with original design data. It ensures alignment between real-world conditions and design assumptions. The model incorporates advanced technologies such as LiDAR systems, 360-degree point clouds, track scan data, and ground-penetrating radar to detect subsurface objects. This approach aids in planning the placement of balises by identifying areas of potential interference, helping to avoid execution issues and ensuring the design aligns with field realities. The focus in 2025 will shift to integrating and demonstrating the developed applications, enhancing the asset management platform and optimising data fusion techniques.
- In Work Stream 4, intelligent asset monitoring for civil assets has been set-up, showcasing technologies and demonstration scenarios, including satellite and aerial surveys, multiple probes, tunnel and subsoil monitoring and sensing solutions for bridges. One of the significant milestone in this work stream for 2024 is the implementation of a geological risk monitoring network. This includes a weather station and wireless clinometers that collect real-time data on embankment movements near rail infrastructure, providing inclination control. The data is integrated into a platform that combines multiple sources, enabling experts to analyse ground behaviour effectively and prevent incidents.

Sub-area 4: Railway Digital Twins

The demonstrations in this sub-area continue to focus on implementing railway Digital Twins (DT) to optimise processes, maintenance planning and logistics related to the design, upkeep, upgrades and renewal of railway assets. DT implementations address common challenges in the railway domain, such

as asset modelling, secure data acquisition and exchange, data fusion, data presentation and behavioural simulation, establishing a reference best practice for Digital Twin deployment. The main goals of Sub-area 4 are to develop methods for implementing Building Information Modelling (BIM) replicas for asset management, connecting inspection and diagnostic data to the DT, presenting and processing DT asset data, and enhancing the DT with behavioural simulation and certification capabilities.

Progress and results achieved in 2024

- Regarding the initiatives related to developing methods to leverage the DT of a station, the BIM model of Málaga Zambrano station has been made available. To support real-world data-based services, initial data sources for station monitoring, such as video feeds from closed-circuit cameras, have been identified. These sources will later be linked to the Zambrano model and to a station in Łódź, Poland.

- Advanced systems for monitoring station cleanliness have been defined. The trash detection system, developed in collaboration with partners, is now able to detect and track trash in real time through a video feed. During a live demonstration, it was shown that the system can recognise and track trash even when it is moved and can use heat maps to estimate high-traffic areas and prioritise frequent cleaning areas. Furthermore, capabilities are being developed to detect hazardous substances, such as broken glass, which may require urgent intervention. The implementation of this system is expected to lead to an estimated 20–25% reduction in operational cleaning costs by optimizing cleaning schedules and resource allocation, while prioritization of cleaning tasks in high-traffic areas is anticipated to enhance passenger satisfaction and safety by approximately 15%. Next steps include implementing a dashboard for station operators to monitor trash presence in real time and prioritise cleaning tasks based on urgency. A classification system for trash types is also being proposed, enabling differentiation between regular and hazardous waste, such as broken glass, for a more targeted and timely response. These advancements are the theme of the development of the UC14.3, emphasizing their strategic importance in station management improvements.

- The Blockchain and Virtual Certification Framework specifications have been drafted. Use Case requirements for the Common Data Environment have been shared with FP1, and synergies with FP4 have been explored to support material traceability and passport management. These processes leverage the same technical solution (Blockchain) designed to track infrastructure certifications within the Virtual Certification Framework.

These developments represent a significant advancement in the digital management of railway assets, enhancing the safety and efficiency of maintenance operations and contributing to the creation of modern, resilient railway infrastructure through the support of DT.

Sub-area 5: Environment, User and Worker Friendly Railway Assets

Sub-area 5 focuses on creating environmentally sustainable, user-friendly and worker-friendly railway assets by addressing sustainable and cost-effective railway lines, new Additive Manufacturing (AM) repair processes, robotic platforms for railway interventions and Augmented Reality (AR) and exoskeleton technologies to support railway maintenance.

Progress and results achieved in 2024

- Significant progress has been made in sustainable and cost-efficient eco-design for rail assets, including identifying the location for a green turnout and completing simulations. Ongoing studies focus on the dynamic effects on bridges and the deployment of geogrids in the French network, contributing to scientific methods for sustainable design.

- Regarding Additive Manufacturing R&I activities, advancements include the testing and qualification of elastomers and flame-retardant polymers to ensure safe and durable spare parts. This is the case of UC17.5 where recent advancements include fire/smoke qualification of three polymer materials, mechanical testing of elastomers printed using fused granulate fabrication, selective laser sintering and reactive chemistry deposition, alongside ongoing exploration of various machines and technologies for printing large spare parts and railway components.

- A Digital Warehouse strategy has been implemented with a shared database, facilitating technology exchanges and the creation of spare part clusters for AM feasibility assessments. Various AM technologies—Cold Spray AM, Laser-Directed Energy Deposition (L-DED), and Wire

Arc Additive Manufacturing (WAAM)—are under investigation for applications such as rail, turnouts and wheel repair. Testing of mechanical properties for promising materials is ongoing, and the development of subsystems for an in-situ AM repair machine, including measurement, heating and material removal, has commenced.

- The robotic platform has completed its initial cycle of development, achieving sufficient progress for field tests despite not reaching the final functional state. This is the case for example of on-track Inspection Robot (UC18.1) that already had two functional mobile bases (one in Sweden and one in France) to carry out tests on real railways tracks. The first level of development of the navigation stack has been successfully tested. Preliminary tests have been carried out on obstacle detection and now need to be coupled with the speed control of the navigation stack. Initial results on the repeatability of localization via GNSS have been obtained, that are on the path to achieve an increase of 25% in the reproducibility of inspections with respect to conventional interventions. Development is proceeding through interactive cycles and testing, focusing on modularity, safety methodologies and broader use cases such as disinfection and installation of ERTMS balises. These efforts aim to address business needs, such as accelerating equipment deployment, accommodating transport growth and improving cost efficiency. Final demonstrations are planned for late 2025.
- For exoskeletons, progress has been made in developing the basic kinematic structure and a novel motor-reduction system that introduces functionalities beyond the state of the art. These elements will converge into a complete system by 2025, validated in proposed use-case scenarios.
- Regarding Augmented Reality R&I activities, the system architecture has been implemented and several AI models are in development. These include models for 6D-pose estimation, image semantic segmentation, and 3D geometry reconstruction, along with exploration of advanced technologies like Gaussian Splatting. These tools will be validated across defined scenarios by 2025.

Flagship Area 4 (FA4): A sustainable and green rail system

The main objective of FA4 is to provide new innovative products and services based on leading edge technologies to minimize 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.

Sub-Area 1: Alternative (to Diesel) energy solutions for the rolling stock

The main objective of sub-area 1 is the demonstration of three Batteries Electric Multi-Unit (BEMU) trains (two high performance and a low-traffic trains), two hydrogen hybrid trains (one heavy-duty inspection vehicle and one locomotive) and, one virtual demonstrator of an on-board energy storage system (OESS) for trains using a catenary.

This will be enabled by increasing the energy density stored on board the train, by extending the range accessible to the BEMU in catenary-free mode from 80 km (present state-of-the-art) to 200 km and by improving the efficiency of the hydrogen traction system and standardizing its' refueling interface.

The physical demonstrations planned as outcomes for this sub-area are high performance battery-powered regional trains (200 km); hydrogen hybrid locomotive; hydrogen inspection vehicle.

Progress and results achieved in 2024:

- Development of innovative next generation propulsion system components and the prototypes of the traction systems have been assembled. The main components, namely the power converter based on silicon carbide technology and the power transformer, are ready to start laboratory tests.
- Complementary to the traction systems, onboard energy storage systems are at various stages of design and assembly, depending on the target demonstrator. Volumes and weights have been analysed to properly define the placement o
- the new components in the demonstrators. These devices are planned to be integrated in three demonstrators: the High-performance North Europe BEMU, the High performance South Europe BEMU and the Low traffic BEMU.

- Studies on energy management models and optimization have been conducted, based on scenarios and methodologies agreed among the project's partners. This enabled the comparison between simulation tools and a standard scenario for KPI evaluation (autonomy, energy consumption, physical CO2 equivalent emissions, noise, Life Cycle Cost reduction). Based on the simulation, the integration of the optimised subsystems from the energy consumption point of view permits to foresee a range longer than 200 km.
- Digital twin architecture description of the train is in progress and ageing bench tests are running, with the first ageing condition data available considering especially the power semiconductors of the train, a necessary step in the train evaluation and certification for virtual validation and certification.
- A lifetime calculation tool for power semiconductors was evaluated and close discussions with the European Center for Power Electronics are still ongoing considering the reliability of silicon carbide (SiC) components.
- Regarding the developments of hydrogen storage technologies on trains, two materials for the hydrogen tank have been considered, simulated and tested: type IV Carbon Fiber Reinforced Polymer (CFRP), also presented at Innotrans, for which bursting tests for characterization and health monitoring system tests have been performed, and type III austenitic stainless steel and aluminium, for which a laboratory scale test for the cracking of the material due to the hydrogen's pressure has been successfully performed. Each material has its own market (low cost solution for the metallic one and optimal solution for range/H2 quantity / weight ratio for the composite). The integration of a structural Health Monitoring System, including damage assessment, is ongoing with the goal of implementing it on a commercial tank for the demos in parallel to laboratory specimens. The detailed energy consumption of one existing prototype was recorded at standstill to be used as a baseline for future work.

Sub-Area 2: Energy in rail infrastructure and stations

The main objectives of sub-area 2 are the improvement of hydrogen refueling stations for the railway sector by standardization, the development and integration of innovative solutions into the legacy railway system to improve and enhance the infrastructure traction power supply and the definition of the requirements and preliminary developments for the use cases of innovative solutions to manage and minimize energy consumption by optimizing the usage of needed resources and reducing the total cost of ownership. The sub-area also targets the development of energy hubs using energy storage for peak shaving and to open the way to powering railway grids using renewable energy sources and local energy balancing solutions. The work also involves defining a pilot project for a new modular station in Poland, as part of the "Building a Modular Low-Emission Station" initiative. Additionally, it includes a pilot for a "Railway Station Energy Digital Twin", to be demonstrated using the example of the Málaga-María Zambrano station in Spain.

Progress and results achieved in 2024

- Configuration for the hydrogen refuelling station has been performed with the support of modelling and the corresponding hazards being revised. The project partners involved in this sub-area started to model the hydrogen refuelling system and process by designing the software tool and gathering the relevant data in the case of a refuelling station being used in conjunction with rolling stock.
- Modelling of standardised operation on an interoperable hydrogen refuelling has been performed. As standardisation is relevant for mechanical devices and interfaces, a first approach for the design of the interface between the refuelling station and the train was described. The adaptation work to make it as compatible as possible with existing international standards is ongoing. In addition, synergies were sought on protocols and data to implement for hydrogen transfer. The results consider lessons learned from the collaboration with the FP6 FutuRe project in the context of a multimodal hydrogen refueling station, as well as from the projects H2goesRail and FCH2RAIL.
- With regard to the introduction of an energy hub as an advanced element of the railway system, for a typical demonstrator of energy storage on DC side, key results were obtained by following a complete and solid process of simulation and validation: at first, definition of different models based on the integration of the Energy Storage Systems (ESS) and Renewable Energy Sources to the railway grid; then, application to the complete targeted line and validation with real measures; at last, simulation to understand the impact of the ESS on the traditional electrical substation. The results of the simulation with the implementation of the ESS allowed to forecast 12 MWh minimum

daily energy saving. This also enabled the definition of optimized energy savings, as well as of the control strategy and components' sizing of the ESS. In 2024, the pilot demonstration of an Urban Energy Hub in a light rail urban environment was designed and installed in Rotterdam.

- Regarding double side feeding of 50 Hz AC traction substations using Flexible Alternating Current Transmission Systems, a realistic line model representative of the railway environment was completed together with a model of a Railway Interline Power Flow Converter to conduct co-simulations. Regarding energy storage solutions for AC railway grids, some key simulation models were completed, such as the railway traction network, the train load and the interface power converters, while the model of the whole system is 70% completed. In parallel, an optimisation and management tool for AC & DC railway grids is under development. The AC and DC grid models are completed, and the relevant use cases have been simulated as the first development steps.
- Regarding progress on the modular station, requirements and of the common data environment has been defined. Key activities for the railway station energy digital twin were completed, including the installation of the sensors and the upload of the Building Information Model (BIM) for the María Zambrano station into the Common Environment Platform. Additionally, scenarios were analysed to determine the optimal positioning of luminaires and of the lighting circuits. The optimum scenario in terms of energy consumption will be used to adjust the lighting based on platform occupancy.

Sub-area 3: Sustainability and resilience of the rail system

The objectives of sub-area 3 deal with the sustainability and resilience of the rail system. This sub-area performs research, develops models, and will demonstrate solutions to better adapt the rail system to climate change and to reduce the impact of vibrations and noise on the surrounding environment.

Progress and results achieved in 2024

- A first list of 37 standards to be revised or to be created for infrastructure charging of alternative drives trains, as well as for on-board energy storage systems has been identified.
- For the optimization of energy consumption at system level, a first methodology was created. Based on use cases and associated scenarios, a list of criterions to compare the performance on operational level, infrastructure level and rolling stock was built.
- As a continuation of the work done on adaptation to climate change, the analysis achieved in 2024 have highlighted the need to carry out vulnerability studies for all railway assets: rolling stock, infrastructure and stations. Pre-existence of methodological tools enabling evidence-based decision-making and strengthening the resilience of rail infrastructure and operations to climate change have been identified. A set of pedagogic presentations dedicated to FP4 partners showing, for each of the 15 key results of the analysis, main conclusions, what this allows, and a roadmap for 2025 and beyond were under finalisation
- The methodology for aeroacoustics source characterization has been written and verified by measurements (on metro and regional trains). In the field of noise perception indicator, annoyance responses of 80 residents along a high-speed line were collected from Spring 2024 and tonality perception experiments were carried out in diverse environments.
- Considering noise and vibrations emissions over lifespan, the impact of the alternative ballast Neoballast on track vibration emissions was assessed with the help of a calculation model. New formulations for Neoballast were also produced, and preliminary comparative laboratory tests with conventional ballast were performed.
- Relevant influencing factors and the installation conditions for gabion walls were determined and a ground-borne vibration mitigation measures catalogue has been compiled.
- Squealing noise studies resulted in a practical approach to specify low squeal rolling stock and to useful insights in possible squeal mitigation methods, as well as in a practical track side measurement approach to monitor squeal noise and to obtain data for noise mapping calculations tools.
- Considering the circular economy solutions, a market study of accessible parts was produced. In addition, a list of criteria enabling the confident exchange of second-hand parts and materials within the railway industry was validated and shared. The specifications for the integration of circularity in a marketplace was drafted.

Sub-area 4: Electro-mechanical components and sub-systems for the rolling stock

The main objectives of the sub-area 4 involve developing and introducing to the market airless electromechanical braking system, pantograph and suspensions. A parallel objective is the optimisation of motors and gearboxes, high performance bogies and suspensions regarding energy consumption and weight, considering new materials following circular economy principles. In the scope of new usage, one key objective is to deliver alternative technologies to replace hydrofluorocarbon refrigerants with HVAC systems using green refrigerants or new cooling technologies with reduced energy consumption. In addition, a global objective for the rolling stock is to introduce enhanced experimental and numerical methods for aerodynamics.

Progress and results achieved in 2024

- Two air-less brake prototypes were studied in 2024. Extensive tests were conducted on a wheel-rail test stand (304 tests done on 3 different pad types, with speed between 0 and 200 km/h, simulated mass between 12 and 17,5 t per axle and brake demand between 0 and 1,2 m/s²) while the integration in the demo train was checked. Disc brake unit and tread brake unit prototypes were manufactured and tested, along with the required control unit. Additional tests on a dynamometer test bench were run to check the behaviour in different conditions according to mission profile.
- A first air-less pantograph was designed and simulated, while its regulation system was tested, and the simulation model to study the interaction between the electrical pantograph and the catenary was initiated. For the second air-less pantograph, the design phase was completed, including the definition of test scenarios and the relevant test-rig adaptations, and simulations of its preliminary 3D model were performed.
- The air-less suspension first concept was studied, its basic principles observed, and a simulation model was initiated to benchmark it against the active suspension concept.
- Regarding the development of a high-performance bogie and its sub-systems, a lightweight wheelset using bolted design with a tubular axle made of an alternative steel material was tested at 1:1 scale. Its serial design for freight wagon wheelsets is planned to be finished at the end of 2024 in order to perform the field test activities planned in 2025, achieving TRL7.
- The development of the concepts and of the configuration for the high-capacity independent rotating wheel (IRW) frame are ongoing and are planned to achieve TRL4. A lightweight bogie frame was defined and work on the material's characterization has begun. In parallel, the design phase of the 275 kW direct drive motor for the high-performance bogie is planned to end in 2024, and the development of a motorized IRW guiding valid for a high-speed train reached TRL6.
- Regarding the development of an eco-friendly HVAC, technologies to be implemented have been selected (Vapor Compressor Cycle using Hydrocarbon) and the vehicles for the demonstrators selected.
- Regarding virtual aerodynamic certification methods and aerodynamics optimised roof and pantograph, the first results of the two numerical simulations with high accuracy regarding crosswind loads and wind resistance were accomplished and the relevant results must be compared. In the associated domain of drag and noise reduced spoiler and pantograph aerodynamic demonstrator, the model train was developed, and the wind-tunnel 3D printed model was built along with the first advancements in the building of a generic pantograph model.

Sub-area 5: Healthier and safer rail system

The Sub-project 5 is designed to reach two main objectives: developing technologies and methodologies ensuring a reduced health risk for rail passengers and staff and building a better understanding of the issue of non-exhaust emissions emitted by wear particles from brakes, wheels-rail contact, pantograph-catenary line contact and assessing the related risks.

Progress and results achieved in 2024

- The evaluation of different ventilation concepts regarding contaminant removal effectiveness and thermal comfort quality was performed by using a generic train compartment demonstrator (mock-up). Different generic state-of-the-art ventilation mechanisms, as well as novel prototypes of ventilation concepts, e.g. headrest-integrated air supply and exhaust, were analysed and

evaluated. Accompanying computational fluid dynamics simulations were performed enlarging the experimental data set.

- The assessment of air quality improvement technologies was advanced and completed. For this purpose, the evaluation list for the different technologies were harmonized and the relevant criteria and weighting factors were fine-tuned. Measurements were then carried out in a coach mock-up for one of the assessed technologies. The measurement corresponds to mock-up level (L2) developed in air quality measurement procedure.
- Regarding the development of an air quality measurement procedure and relevant visualization tools. two levels of protocols were defined and tested in 2024 with a good repeatability: at component level (L1) and at mock-up level (L2) for Air Treatment, Surface Treatment, and Air Quality micro-sensors.
- Several studies were performed to define a pre-standardised method to measure, compare and report the air quality in underground stations. A comprehensive review of international regulations and recommendations was undertaken, which identified the main threshold values set by these guidelines. These findings outline the European context, including values specific to France and Sweden, as well as the international context with key values identified for South Korea and Taiwan. Low-cost sensors were also evaluated in the Stockholm metro to investigate their calibration processes. The main conclusion was that the quality of each low-cost sensor m
- To progress further, different low-cost sensors are being evaluated in Arlanda Central Station. In parallel, a rich bibliography covering the past five years and the Ultrafine Particles description (UFP) were completed.
- Existing simulation tools serving as a solution to predict air quality on covered platforms and in tunnels have been validated. The development of two predictive tools, based on AI (machine learning, neural networks, and multi-factor interaction model) for air quality prediction in underground stations, is currently underway. Thanks to the relevant simulation tool, it is now possible to identify how different train fleets influence the air quality at the underground metro platforms in Stockholm.

Sub-area 6: Trains Attractiveness (Interiors)

The sub-area 6 is dedicated to the train attractiveness through the enhancement of various elements and aims to develop technologies and interiors design by facilizing:

- Rolling stock adaptation with refurbishment and regular evolving layouts, and innovative concepts to support the increase of capacity of the rolling stock targeting TRL6 in 2025 and preparing for later evolutions.
- Reduction of the environmental impact by using an interior designed for circular economy with specific materials, shapes or assemblies done for the re-use or for very low impact during the life of the train.
- On-demand comfort for users, as well as new architectures to increase passenger capacity

Progress and results achieved in 2024

- Regarding the modular systems, studies were carried out on quick fasteners, impeding a quick reconfigurability of interiors, for which aircraft suppliers were consulted for feasibility and train operators for usability. Additionally, fire resistance and electromagnetics tests of electrical power systems without cable were prepared.
- Regarding new materials and circular economy, circular economy and integration in the interior design was defined, each material's recycled content potential as well as issues according to recyclability potential were identified. Special focus was given to interior components made of fiber reinforced polymers for which industrial recycling methods and techniques were investigated, and optimum recycling methods are being identified. In parallel, laboratory tests of new materials for interiors design started, particularly smoke and fire tests. The application of these concepts to seat beams in recycled composite is also progressing.
- Two complementary train virtual configurators are in development which are the first topic for modular interiors, allowing to build the train's interior layout in compliance with the verification of various requirements (e. g. legal, regulatory, and client-derived ones). One configurator which is

customer-oriented, reached the level of mock-up demonstration to test with customers. The other one which is more design phase-oriented, has been tested by design engineers working in FP4-Rail4EARTH. A real static vehicle restored in 2024 dedicated to intermediate validation (e.g. fixing solutions test or new materials test in real environment) will complete these configurators.

- The description of the modular architecture pillars to provide a railway-compliant solution for mounting and dismounting interior modules that may be fast, frequent, and safe as well as the fastening concept for the interior top area have been defined.
- The insulation using single-wall extension extrusions with the aim of saving weight and increasing the passengers' comfort has reached concept phase.
- The definition of the acoustic impact of a modular interior by simulation, for which a first numerical simulation to define the final impact for passengers has been performed.
- To pave the way to standardizing the interiors fixing lines avoiding the recourse to tailor-made designs, a first analysis on requirements and a numerical calculation of impact of the height of the fixing line has been conducted.
- Finally, regarding the topic of hygiene, the development of a full-scale toilet mock-up for testing systems to enhance passenger experience has been performed and its' concept is now frozen. In addition, hygiene design solutions using the biomimicry method have begun, reaching the stage of ideation.

Flagship Area 5 (FA5): 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 the Digital Automatic Coupler (DAC). The DAC enables more functionalities in freight, 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. FA5 tackles these challenges through two interlinked clusters.

WS1 Full digital Freight Train Operations with DAC as enabler for full digital freight train operation

This cluster focuses on increasing the productivity, quality, and capacity of rail freight by applying digitalisation and automation to all possible operational functions and processes, including innovative freight assets, with the overall goal of Full Digital Freight Train Operations (FDFTO). The FA5 activities are aligned with the EN 50126-1 standard (i.e. considers the generic aspects of the RAMS (Reliability, Availability, Maintainability and Safety) life cycle), starting with systematic requirements capture and leading up to an extensive three-phased testing process. Prototypes are tested in test rigs to ensure functionality and interoperability. This is then validated in a closed environment in the Train Test Lab and integrated into assets like wagons and locomotives. Final tests take place in demonstration trains to test interoperability and functional readiness in real-world infrastructure.

The significant achievements in 2024 show that the progress is progressing from an analytical-focused phase with requirements capture, specification definition and architecture work towards testing and validating developments.

Progress and results achieved in 2024:

- After establishing Target Operational Procedures and completing the Risk Assessment the definition of the Reference Freight System Architecture was achieved. This architecture is described in the comprehensive documents presenting the **Physical Reference System Architecture FDFT** and the **Digital/Data Reference System Architecture FDFT.**
- In addition to the architecture requirement specification has progressed significantly. Functional and non-functional requirements are covered in the relevant technical reports dealing with **functional Requirements Specification of Train Functions, Technical Specification of Wagon Power System and Communication System and** the FDFTO User requirements focusing on operational needs.
- The planning of the testing of these requirements and the developed solutions is concluded in the **consolidated Full System Integration Plan, Test Concept & Validation Concept and Plan.**

- Field trials and prototype testing moved forward, confirming interoperability and preparing for real-world deployment. The results are documented in Functional Test Reports and Interoperability Test Reports for DAC Level 4 (i.e. no automatic uncoupling)
- Part of the testing was as well a major campaign to assess different e-coupler designs leading to decision for this crucial component of the DAC.
- The DAC commercial demonstrator train in Sweden marked a major milestone, with successful tests providing valuable data for future enhancements and providing essential data on Life Cycle Costs (LCC) and performance under harsh winter conditions.
- Safety and IT-security analyses for Automated Shunting Operations (ASO) have been completed, focusing on ensuring safe and secure operations of the upcoming of Flat and Hump Yard Shunting demonstrations. Additionally, a preliminary Safety Integrity Level (SIL) investigation supports achieving an ASO safety design based on safety functions with a SIL ≤2.
- Collaborative efforts continue to enhance design flexibility and optimize operational efficiency, underpinning the project's commitment to a seamless and modern rail freight system.
- In the Innovative Freight Assets progress has been made in terms of a **report for efficient loading/unloading, aerodynamic characteristics and efficient driving specification** presents the collaborative work from the partners on freight-train operational efficiency, focusing on aerodynamics and efficient driving.
- At InnoTrans 2024 the project showcased the interoperability of DACs on the trade fair to the public and demonstrated the development progress achieved during the DAC High-Level Event to a broad audience of stakeholders, including political representatives, operators, suppliers, and customers.

WS2 Seamless Freight: with easy access and reliable (intermodal) transport service offering digital solutions.

This cluster addresses the efficiency of the informational (data) layer of transport, aiming to save time and reduce costs by ensuring a seamless environment for planning, execution, and management among different actors, countries, and modes. It focuses on both long-term integration and short-term achievements, with progress in dynamic dispatching, video gate systems, and seamless planning, ensuring the development proceeds in a coordinated and efficient manner.

By integrating these two clusters, FA5 is well-positioned to enhance the attractiveness of rail freight through increased capacity, operational efficiency, and environmental sustainability. The continuous development and alignment within these clusters underscore FA5's commitment to driving forward the vision of a modern, efficient, and integrated rail freight system in Europe.

Over the past 12 months, significant progress has been made in initiating work related to the Seamless Freight cluster. The primary focus has been on delivering essential functional and technical specifications regarding the CMS, which have provided critical input for FA3. In parallel, FA5 has successfully completed several important tasks that form the backbone of the current and future development efforts.

Progress and results achieved in 2024:

- With its report on **High-Level Specification of Requirements** the cluster outlines the freight sector's needs, identifies the challenges and describes a clear vision of the future target state from an operator's perspective: Seamless Freight.
- The complementing report on **Basic Functional and Technical Specifications** provides a detailed overview of the technical enablers required for the Seamless Freight vision. Both documents are fundamental for the collaboration with FP1 to ensure that all functional aspects are aligned with technical capabilities.
- Building on this foundation the current development work focuses on these technical solutions:
    - **Real-time and Short-term Dynamic Dispatching Tools**: aiming to enhance the efficiency, adaptability, and responsiveness of dispatching operations, ensuring smooth rail freight flows.

- **Intelligent Video Gate**: Leveraging advanced video technology, this initiative focuses on streamlining freight handling processes and improving monitoring capabilities.
- **Seamless Planning of Rail Freight Services**: Optimizing the planning process to reduce bottlenecks and inefficiencies, this development ensures a smoother, more coordinated freight operation.
- **Rail-centred Intermodal Monitoring and Prediction Systems**: By integrating rail operations with other transport modes, this system provides enhanced monitoring and predictive capabilities, fostering improved reliability and efficiency.

- Enhanced collaboration ensured that all work streams are aligned and moving cohesively towards achieving its goals.
- The progress has been regularly reviewed and demonstrated at key industry events, reinforcing the project's impact and future direction.

By comparing the progress from 2023 to 2024, it is evident that the efforts have transitioned from foundational planning and strategy development to detailed technical implementation and testing. The project has seen significant strides in achieving interoperability, improving operational procedures and integrating advanced technologies within the European rail freight sector. The emphasis on collaboration across work packages and stakeholders has been fundamental in driving forward the vision for a connected, efficient, and modern rail freight system.

Flagship Area 6 (FA6): Regional rail services/Innovative rail services to revitalize capillary lines

The overall objective of Flagship Area 6 (FA6) is to ensure long term viability of regional railways by decreasing the total cost of ownership (TCO), in other words, cost per passenger/ton kilometre both in terms of operational expenditure and capital expenditure, while offering a high quality of service and operational safety. In addition, the aspired results aim to increase customer satisfaction and to make rail an attractive and preferred choice of transport mode. These goals are expected to be achieved through a concept tailored to regional railways that includes digitalization, automation and utilization of mainstream and emerging technologies for signalling and trackside components, rolling stock and customer information.

In the first phase of the programme, FA6 is implemented via the project FP6-FutuRe.

Sub-Area 1: Regional Rail System Solutions/Architecture

The purpose of this area is to provide technical support and manage the functional and system interfaces of the technical enablers covered in this flagship area and align with the other flagship areas and the system pillar.

The main objectives of this Sub-Area are to identify a harmonised and integrated high level railway architecture and requirements suitable for all kind of regional lines according to the overall objective to optimise the operational and capital costs. In addition, this sub-area evaluates the safety principle and the migration strategy applicable to regional lines.

Progress and results achieved in 2024:

- The specific requirements for regional lines have been revised based on feedback from the System Pillar and other Flagship Projects and represent the starting point for the development of demonstrators and for the beginning of safety verification activities. These requirements will be revised and updated when all the development, verification and validation activities at different levels are concluded.
- KPIs methodology aiming to measure the achievement has been identified including a measurable criterion for each KPI and a preliminary qualitative justification of the technical enablers to contribute to the expected KPIs.
- The safety analysis started from the defined architecture, the possible associated hazards were identified and cooperation towards the technical WPs for the analysis of possible mitigations began.

Sub-Area 2: Regional Rail Command, Control and Signalling CCS & Operations
The Regional Rail CCS & Operations sub-area focuses on finding suitable Command, Control and Signalling (CCS) solutions and defining preparatory demonstration activities by using existing and potential

interoperable standards applicable on European G1 lines (i.e., lines or network of lines that are connected to the railway network, forming together the Single European Railway Area (SERA) in accordance with the Directive 2016/797/EU) to ensure their long-term viability of the CCS system by reducing the capital and operational costs while taking into consideration regional lines specificities. More specifically, the abovementioned CCS solutions cover:

- Automatic Train Operation (ATO), up to Grade of Automation 4 (GoA4)
- European Train Control System (ETCS) Level 2
- Traffic Management System (TMS)
- Absolute Safe Train Positioning (ASTP)
- Train Integrity and Length

Progress and results achieved in 2024:

- Use cases and scenarios for ATO in different GoA (from GoA2 up to GoA3/4 demos) have been developed which allows automation of train operation on low-traffic lines with moderate speeds. The ATO functionality developed is using ERTMS/ETCS as a platform. The following aspects were addressed: discretional stop; operation under high odometry error; temporary speed restriction; level crossings; radio hole; prove clear ahead; object on the track; adhesion management; remote driving; and regional G1 line – main line interoperability.
- Use cases and scenarios for ETCS L2 demonstrators have been developed by addressing two main topics Hybrid Train Detection (HTD); and Moving Block (MB).
- A set of Use Cases and Scenarios that reflect the operational behaviour of a Regional Line, in relation to some Traffic Management System (TMS) functions has been defined. Two main topics are addressed in this activity which are: Conflict resolution; and adhesion management.

- A set of Use Cases and Scenarios that reflect the operational behaviour of a Regional Line, in relation to some absolute safe train positioning (ASTP) functions has been defined, such as the provision of safe position and speed for train supervision, reduction of railway track maintenance cost by providing accurate faulty track locations and ensure continuous and precise geo-positioning of the train during periods of GNSS signal unavailability.
  - The specification of the systems for determining train integrity and train length for applications with ETCS signalling systems has been defined together with use cases with the aim to complete interoperability between main lines and regional lines is required.
  - As a result of the use case development, a requirement specification is reported, which shall be transferred to FP6-FutuRe Sub-Area 1.
  - The preparatory works to the demonstration activities linked to the technical enablers have been launched considering the identified use cases.

Sub-Area 3: Regional Rail Infrastructure Assets

Assets represent a significant cost factor in regional railway systems. Reducing asset costs, both in terms of capital expenditures (CAPEX) and operational expenditures (OPEX), is critical to lowering overall system costs. The focus of Sub-Area 3 is to develop cost-efficient assets specifically tailored to regional railways. This is achieved through strategies such as simplifying systems and eliminating cabling for data transmission and power supply. Additionally, Sub-Area 3 is advancing a 5G communication concept and prototyping energy self-sufficient wireless assets, while also enhancing Smart Wayside Object Controllers (SWOC).

Smart Wayside Object Controllers (SWOC) are advanced devices that manage and control various wayside objects, including signals and trackside equipment, integrating modern technologies to improve functionality, efficiency and safety. The first half of the project concentrated on developing requirement specifications through a collaborative effort between industry, infrastructure managers and scientific institutions.

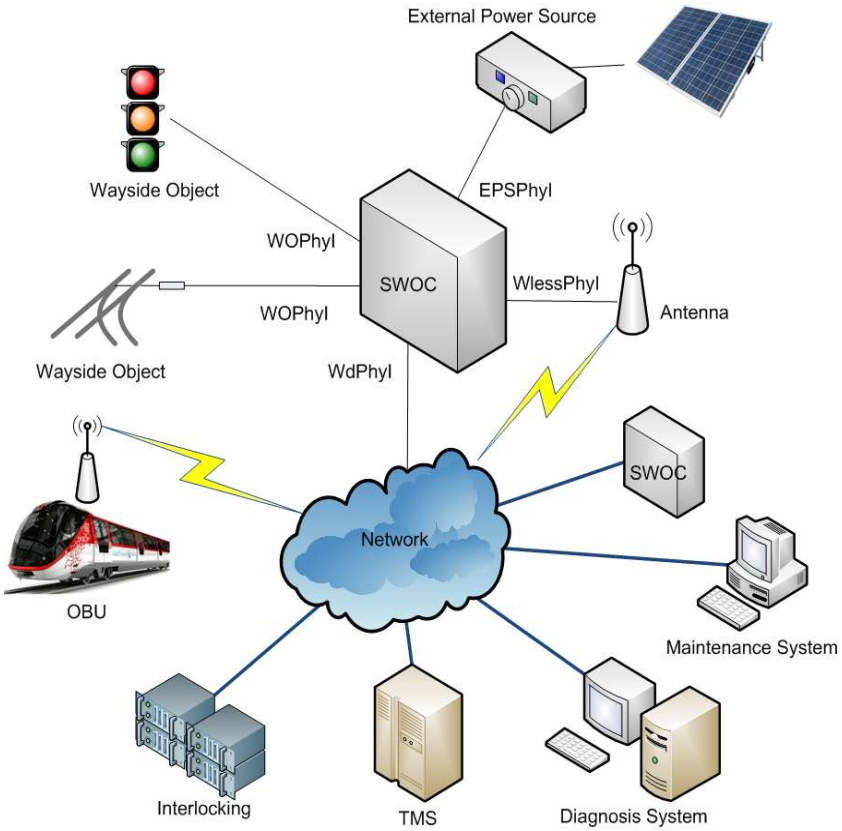


Figure: SWOC System Physical Context

Progress and results achieved in 2024:

Throughout 2024, the project made substantial progress in finalizing requirement specifications, leveraging innovative approaches to develop new way side solutions with the objective to reduce costs and increased efficiency which will be demonstrated during the 2nd half of the project. The specification work builds on previous results from Shift2Rail (S2R) and other research and innovation (R&I) projects.

- defined the operational and functional requirements and reference use cases of level crossings, switches and obstacle detection systems. In addition, analysis of the use of machine learning and artificial intelligence components regarding safety aspects, a social-economic analysis and configuration has been carried out and the architectural framework and interface definitions were finalized.
- defined the operational and functional requirements and reference use cases of the external wireless interfaces of Smart Wayside Object Controller (SWOC) Multi Modal Level Crossing (MMLX). This included detailed work on both upper and lower layers of the open systems interconnection (OSI) model, as well as track-to-track communication specifications.
- adaptable communications architecture for the European railways sector in a context of the adoption of the new standard FRMCS or cost-effective wireless solutions for regional lines has been carried out. This architecture seeks to optimize both operative costs (OPEX) and capital costs (CAPEX) for the regional lines, while improving network capabilities such as bandwidth, latency, and availability and enable new applications due to these improvements.

Sub-Area 4: Regional Rail Rolling Stock

This sub-area aims to develop cost efficient vehicle concepts for G1 and G2 lines. The G2 lines differs from the G1 lines by being functionally separated from the main line, hence not requiring interoperability.

A novel lightweight regional emission free vehicle with significant weight reduction, flexible, modular solutions for vehicle interior for passenger vehicle is under the consideration. The sub-area also includes a development of efficient and sustainable vehicle-centric CCS for G2 lines.

Progress and results achieved in 2024:

- A state-of-the-art report covering regulations and market situation, aiming to ensure that the specific needs of regional lines are considered regarding regulation and customer service has been made. This report includes an extensive data base of existing regional rolling stock, innovative approaches applied, state-of-the art on automatic train operation and market prices. The present legal framework has been analysed and potential issues have been identified where deviations might be needed to allow design of a cost-effective regional train.
- Analysis for the development of the specifications for mechanical architecture of rolling stock was performed considering the area of mass reduction, topology and material use. Models of the carbody and the running gear have been built and the performance studied.

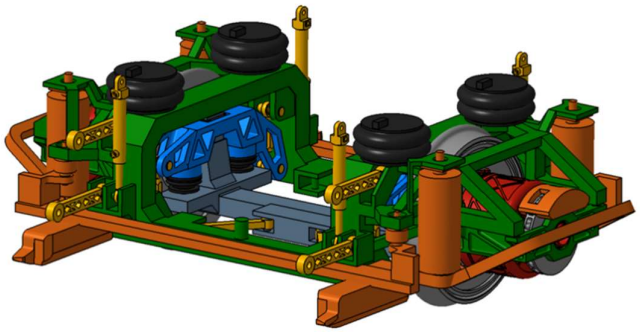


Figure: Illustration of a possible single axle running gear

- The state-of-the-art and legal framework of multimodal fuelling station has been performed as well as the analysis of multimodal hydrogen stations capable of serving a diverse range of vehicles, including trains, buses, trucks, and potentially even aircraft has been caried.
- A state of the art analysis on the regional non interoperable control command signalling system has been carried out, the high level G2 architecture concept and requirements were refined as input to Sub-Area 1, the G2 use-cases to G2 Lines associated demonstration scenarios were developed. The methodology developed suggested minimal architecture specifications, telecommunication agnostics, reduced use of wayside components such as track circuits and axle counters and the use of cloud computing.

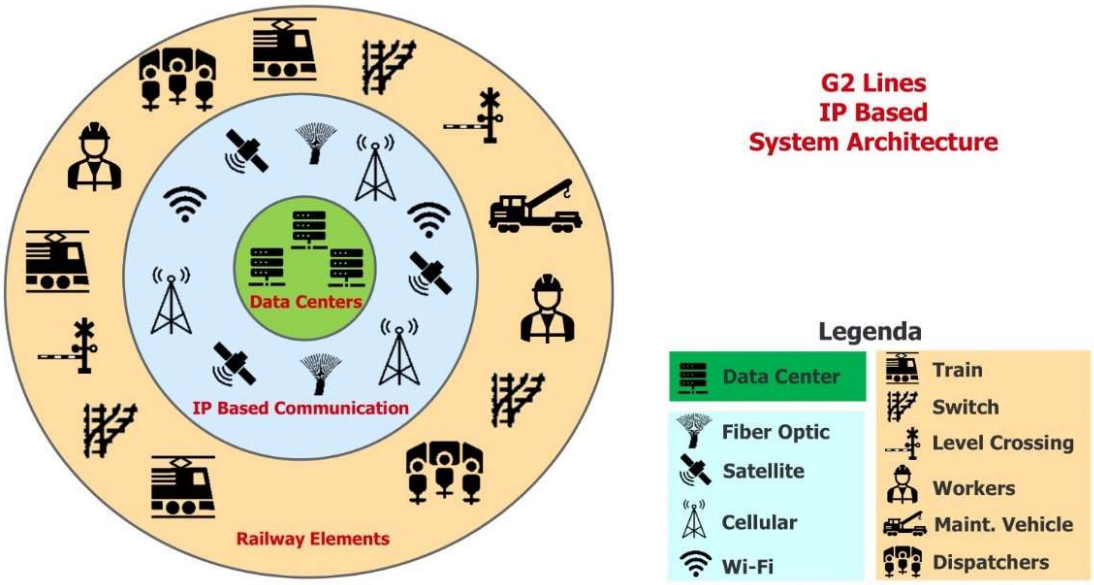


Figure: G2 Control-Command and Signalling

Sub-Area 5: Regional Rail Customer Services

The focus of Sub-Area 5 is to provide customer services centered around passenger information systems (PIS). The objectives comprise the development of a multimodal trip planner that includes demand responsive transport (DRT) options for first and last mile transport and that offers support for passengers with reduced mobility (PRM). Another objective is to integrate a PIS with a Traffic Management System (TMS) so that information can be shared in order to improve planning in both realms.

In addition, the goal of Sub-Area 5 is to ensure good data quality, standard data formats and standardized interfaces will be applied wherever possible, and gaps in existing standards will be identified.

Progress and results achieved in 2024:

In 2024, the work in Sub-Area 5 concentrated on finishing specifications so that the subsequent implementation phase has a solid basis. As a part of the specifications, consequently, use cases were defined and refined, requirements were derived for the use cases, acceptance criteria were phrased, and test cases were written.

- The specifications for the integration of demand responsive transport (DRT) for first and last mile transport into the multimodal trip planner was carried out together with the simulation of DRT operations to define an optimal fleet size in a rural area and the support of distributed trip planning including DRT trip options while provide support to persons with reduced mobility.
- Definition of requirements and design for an interface between traffic management system and passenger information system was carried out and four use cases were defined. Three use cases were concerned with transferring demand forecast data for regional train services from a PIS to a TMS. The fourth use case describes timetable updates on TMS side, such as delayed departure times or platform changes, that are transferred to the PIS.
- Machine learning algorithms to forecast short- and long-term travel demands for regional rail services have been developed. The work outlined the methodology, use cases, system actors, capabilities, requirements, and high-level architecture for the demand analysis system. The work reflected the importance of accurate demand forecasts to improve operational efficiency, reducing costs, and enhancing passenger experience by dynamically responding to changing travel demands. It also highlights the integration of various data sources, such as journey planning requests and historical

- occupancy data, to train and update the machine learning models. The technical work was aligned with Flagship Project 1 (FP1 MOTIONAL) WP24.
- Specifications for passenger congestion monitoring was developed with the focus on regional lines and their connections to main lines, alongside the associated passenger flow. By gathering and processing relevant data such as weather data, and through effective interaction with travellers by collecting their feedback. While machine learning algorithms will be used to predict congestion based on demand and weather forecasts, an optimization algorithm will be applied to determine an optimal allocation of reg
- onal trains to platforms in a big station so that transfer times for passengers are maximized what also reduces congestion at the station.

Flagship Area 7: Innovation on new approaches for guided transport modes

The objectives of FA7 is to explore non-traditional and emerging flexible and/or high-speed guided transport systems, as well as to create opportunities for innovators to bring forward ideas for shaping those future systems via a scientific approach into an existing rail system. This shall provide socio-economically efficient and long-term sustainable transport for citizens and businesses throughout Europe.

MaDe4Rail

The Maglev-Derived Systems for Rail (MaDe4Rail) project addressed an opportunity for a critical challenge in Europe's railway sector: enhancing rail system performance without extensive infrastructure modifications. The project explored integrating linear motors and magnetic/air levitation, used as propulsion and guidance systems, within existing rail networks to ensure seamless integration, cost-efficiency, and scalability.

Progress and results achieved in 2024:

- A roadmap for the development and implementation of Maglev Derived Systems (MDS) in the European rail network has been established, following a stepwise approach toward commercially ready systems for both freight and passenger services.
- A risk analysis was conducted to evaluate the hazards and risks associated with various MDS configurations such as linear motors and magnetic or air levitation systems. Risk control measures were proposed for each identified risk, and all residual risks were subsequently deemed tolerable after mitigating either their residual severity or, more commonly, their residual frequency.
- A gap analysis was conducted to identify necessary updates to existing standards and regulations or the creation of new ones to enable MDS implementation. This analysis highlighted the need for new standards addressing elements such as linear motors, magnetic levitation components, interoperable operations, and testing protocols. Additionally, updates to existing standards were deemed essential due to the introduction of these new components.
- In alignment with market needs and technology readiness levels (TRL), potential MDS applications and use cases were identified, with in-depth technical and financial assessments, including Cost-Benefit Analyses (CBA), performed for the most promising ones.
- Based on the functional, operational, and commercial requirements of the various defined MDS configurations, the project developed concepts for MDS vehicles and a high-level prototype design. This included interfaces with infrastructure subsystems, such as switches, power supply, and traffic management systems, all of which were analysed comprehensively to support further technology development and scalability.
- Finally, a roadmap was established to guide the future development of MDS technologies toward commercialisation, focusing on overcoming key technical challenges to ensure full interoperability with existing rail systems.

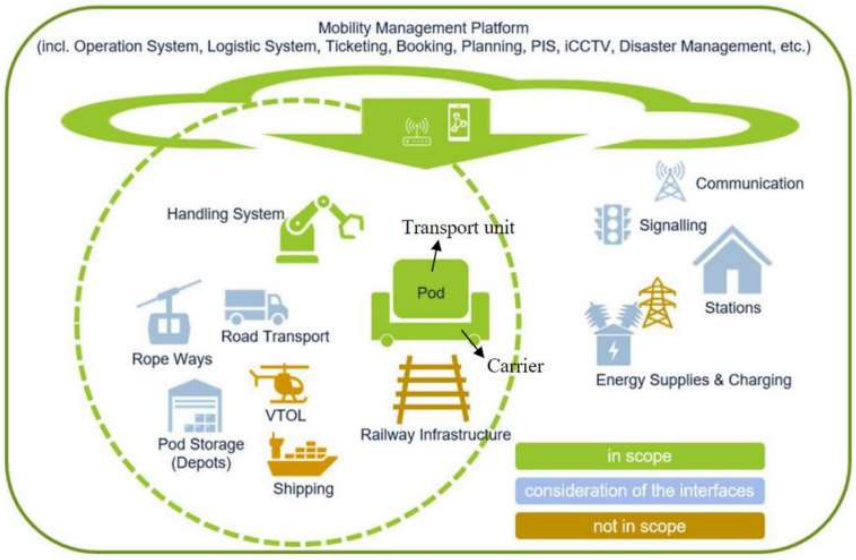
Pods4Rail

Pods4Rail project aims to achieve the vision of a rail based fully automated supermodel mobility system for passengers and goods, which is standardised, scalable and suitable for all transportation modes. The ambition is to develop of a new autonomous multi-modal transport system (Pod System) based on railway

switching fast from rail to another transport mode such as road or funicular and thus creating a continuous transport chain from house to house without changing the transport system.

Progress and results achieved in 2024:

- The analysis of the existing safety framework and compilation of the presumably relevant safety requirements. Due to the supermodal approach, standards from rail, road and cable cars domain were analysed.
- More than 20 use cases were identified with a wide range of usage and design options for the transport units considering both passenger and freight services.
- Two surveys were carried out one for passenger and the other for freight services. This outcome of the survey supported the finalisation of the SWOT analysis of the autonomous Pod system.
- To determine the economic boundary conditions for the realisation of the proposed POD system, an estimation of economical effort was carried out. The scenarios for freight and passenger transport gave a first indication of costs of current transport systems as a boundary condition under which the Pods system should operate which was supported with a qualitative estimate of the impacts.
- A high-level functional requirements specification was developed. It represents a foundation for the Pods System concept and design specification of involved components or subsystems such as Operation and Planning System, Logistics and Storage, Ticketing and Booking, Passenger Information System, Incident Management, Handling System, Transport Unit, Rail Carrier Unit, Coupling System and Road Transport.
- Generic Business Case Elements and Business Case Study for selected Use Cases were carried out. Aim of the Business Case Study was to evaluate a variety of specific Pods4Rail Business Cases for target customer markets with regards to Use Cases to increase efficiency and sustainability in the mobility sector. It includes a feasibility assessment of the selected business models into the current market might be given qualitative statements on the costs and benefits of the Pods4Rail Business Cases.



- The Concept Proposal for the System were completed. A general structural design of the Transport Units was developed including the required power and energy of the HVAC system. Furthermore, energy transfer concepts between the Pod system and the carrier are considered. In the second half of the project, to ensure compatibility and interoperability between transportation modes, a comparison of concepts for coupling (docking) was carried out and a definition of the necessary interfaces between vessel (pod) and carrier developed.

Hyper4Rail

On the 1st of December 2024, the Hyper4Rail project "A Giant Leap for Loop: Towards a harmonized implementable Hyperloop concept" was launched. Gathering 25 partners, the project aims to harmonise and realise a concept design of the hyperloop system (TRL2), to validate the subsystem technologies required for the development of transport systems in a low-pressure environment (TRL4) and to define a common roadmap for the integration of hyperloop technology into the Trans-European network.

The project started it's kick off meeting and developed a survey to gather and define how the hyperloop system should operate from the perspectives of both end users and stakeholders.

Exploratory Research

Academics4Rail

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 the academia teaming up with the industry) on the following topics:

- PhD1: Aerodynamics of freight trains.
- PhD2: Electromagnetic compatibility.
- PhD3: Additive Manufacturing in wheel re-profiling.
- PhD4: Digital communications for virtual coupling.
- PhD: Prognostics and health management approach for railway asset maintenance.
- PhD6: AI-based Driving Assistance.

Progress and results achieved in 2024

The Academics4Rail project has made good progress in 2024 across the various work packages, focusing on key technical advancements and organizational strategies.

- In the framework of the construction of a European rail excellence scientific, the project has delivered a tool for mapping national rail research themes and funds and an infographic to summarize all the findings, contributing to the project's broader dissemination efforts, will soon be developed. Progress has also been made regarding the establishment of a scientific observatory for Europe's Rail , focusing on identifying research gaps in current rail studies and shaping future research directions. A questionnaire is being prepared to consolidate insights and contribute to the achievement of the work package's critical output, i.e. the identification of key research themes for future PhD projects, which will contribute to addressing current technological challenges in the rail sector. The development of an overarching assessment framework that will support an evidence-based assessment methodology of how Europe's Rail's activities are delivering against its aims and objectives is under development.

- The above-mentioned six PhDs are advancing, and the researchers are now finding the right journals to submit the ongoing work. Progress on PhD1 includes research on the aerodynamics of high-speed freight trains, with simulations and the development of a freight geometry database underway. Recommendations were made to present the operational benefits of this research in a more accessible manner, highlighting energy savings and improvements in container loading patterns. For PhD2 efforts are concentrated on enhancing rail network safety through improved electromagnetic compatibility (EMC) strategies. PhD3 is exploring the application of additive manufacturing for wheel reprofiling, with a focus on material testing and laser cladding. The involved Project partners are evaluating the potential impact of these advancements on reducing rail wear through the use of harder materials. In PhD4 the use of 5G wireless communication systems to enable virtual coupling of automatic trains, with an emphasis on dependability and safety in train-to-train communications, is being investigated. PhD5 has been advancing research on rail surface material maintenance using both classical and quantum neural networks. This work aims to optimize rail maintenance through predictive models that estimate the remaining useful life of rail surfaces. Lastly, PhD6 is addressing the development of AI-driven driving assistance

systems, which seek to balance human-machine interaction while optimizing driver performance and are key to improving operational efficiency and safety in automated rail systems.

InBridge4EU

The InBridge4EU project aims to address open points in the current Infrastructure Technical Specification for Interoperability (INF TSI). These include the Dynamic Train Categories (DTCs) specified in EN15228:2015, the validity limits of static compatibility checks in EN15228:2021, the accuracy of dynamic amplification factors and damping values for railway bridges proposed in EN1991 2 (2003) and the deck acceleration limits imposed by EN1990-Annex A2 (2005) for both new and existing bridges. The project seeks to develop an enhanced and harmonized method to assess the European dynamic interface between railway bridges and rolling stock.

Progress and results achieved in 2024

During the year 2024, the InBridge4EU project has achieved the following results:

- Significant progress has been made in defining Dynamic Train Categories (DTCs) for train-bridge compatibility. Preliminary data on passenger and freight trains has been collected, including vehicle dynamic data and statistical analysis. Moreover, due to the limitations of current spectral methods, Residual Influence Line (LIR) is preferred over Decomposition of Excitation at Resonance (DER). Various dynamic train categories are being considered based on statistical analysis to generalize proposals for compatibility checks. The goal is to determine limits for static checks, including permissible speed per train category.
- To identify critical bridge parameters for assessing the economic impact of the new DTCs, data for 520 bridges has been collected, exceeding the initial target. Partners have agreed on numerical models for bridge analyses and are sharing computational tasks. Additionally, 25 train models have been selected, and specifications for dynamic analyses of simply-supported bridges has been agreed on and the first calculations have started.
- Research on the dynamic amplification factor φ″ is based on a large database of track irregularities from the Swedish railway network. Simulations and statistical analysis have shown that the dynamic factor depends on the bridge span length, the train speed and the track quality.
- Regarding the revision of damping in railway bridges, data from over 60 bridges in 5 countries has been collected, including around 600 timeseries of train passages. Damping has been estimated using Multi-Criteria Optimization and SSI-COV methods, with benchmarks showing satisfactory results between the two methods.
- The study on revising the bridge deck acceleration limit included designing and building a shake table rig, informed by a literature review and expert questionnaire. Experimental testing on a full-scale bridge in Sweden was performed in September 2024. The first experimental tests at the shake table tests will be used to validate Discrete Element Method (DEM) simulations, which have already been performed to reproduce previous findings. Train-Bridge-Interaction analyses using Finite Element Method models with ballastless tracks found no correlation between deck acceleration and running safety. Additionally, a new algorithm was developed to calculate partial safety factors in ballasted track bridges, suggesting that safety factors lower than 2 can be proposed for existing structures.

In parallel to the work described above, the project is also progressing swiftly in the definition of the relevant normative recommendations that arise from the technical topics developed.

RAIL4CITIES

The RAIL4CITIES ("RAILway stations for green and socially inclusive CITIES") project aims to trigger the transition of railway stations in Europe into real promoters of sustainable cities, by developing a new operational, readily available, and highly applicable model of stations (SCP model), combined with a common European methodology and tools for its effective implementation. The project will be put into practice through five living labs, each tailored to specific station transformations. The goal is to create a blueprint for transforming stations into engines of urban sustainability and integrated service hubs.

Progress and results achieved in 2024

- After 18 months of operation, the project has successfully published a first iteration of the methodology, with the introduction of a new operational model for stations as Sustainable City Promoters (SCP) and of a methodology for the impact analysis, relying on Sustainable Return on Investment (S-ROI) and integrating environmental and social factors, in addition to the economic costs and benefits (CBA)
- Moreover, the Project has delivered the detailed roll-out methodology linked to the SCP model for Living Labs, testing and refining it in real-world scenarios, and providing an impact assessment and recommendations for refining the SCP model in subsequent work to be performed. The placemaking activities, targeting to engage local stakeholders, including citizens and station users, to promote the revitalization of underutilized spaces near railway stations, have been described with the aim of discovering the local assets and potential of these spaces, leading to more impactful projects that meet community needs and aspirations.

Leader 2030

The LEADER 2030 (Learnings for European Autonomy to Deliver Europe's Rail in 2030) project has for main objective to conduct research activities aiming at providing answer to the following key question: "will there be enough raw materials and components to bring to the market in 2030 all the Railway innovations EU-RAIL is delivering?".

Progress and results achieved in 2024

During the year 2024, the LEADER 2030 project has achieved the following results:

- Completion of the analysis of other industrial sectors having similar characteristics with the Railway sector, in order to study if they show resilience patterns we can learn from. The research focused on the Aerospace, Defence, Automotive, Clean Energy sectors. The final results show that all sectors have been heavily hit by the many 'unexpected' events causing supply disruptions, and that if innovation-led evolutions are creating more disruptions as they require e.g. more critical raw materials and components, on the other side it is from innovation that possible solutions may arrive.
- The analysis of the EU-RAIL Master Plan and Multi-Annual Work Programme (MAWP) aimed at identifying in detail what components are necessary to produce each target innovation has been almost finalised. This kind of analysis has been possible also thanks to a broad set of Focus Groups/Interviews run with EU-RAIL Flagship Projects' Coordinators and key Partners, as well as with other relevant EU-RAIL Projects and European RUs, IMs and OEMs not involved in any project: this made it possible both to challenge and validate the results of the desk analysis and to listen to the target market about the actual plans for market adoption of the innovations funded under the EU-RAIL programme. The analysis also identified the raw materials and processed materials necessary to each production input of such innovations, as well as what components will become obsolete as a result of such innovations.
- The work to describe in factsheets all raw materials needed by the Railway sector for its innovations has been initiated and will be finalized in 2025.
- The project Coordinator, Ms Veronica Elena Bocci (ERCI / DITECFER) has been awarded the "Women in Rail Award 2024" in the category "Research and Innovation" assigned by EU-RAIL, European Commission, CER, EIM, ALE, UNIFE. The Award was assigned "for her significant contributions to rail technology and innovation" for the "LEADER 2030" project.

DACcord

The DACcord as a Coordination and Support Action aims to support the running and overall management of the European DAC Delivery Programme (EDDP) including its programme risks and interfaces, refine the DAC migration roadmap and develop major criteria/options for overall migration/deployment scenario optimisation.

Progress and results achieved in 2024

- The DAC migration roadmap was refined and further developed, based on the multi-annual work programme and in cooperation with all EDDP work areas and stakeholders, integrating further related EU-Rail projects and all sorts of timing, including milestones, key deliverables, required interactions and related resource availabilities. This work was continued through executing and managing the DAC migration roadmap and on the EDDP Stakeholder Management.

- A main achievement was the development of the revised DAC General Master Plan 02, taking into account all recent evolutions/interfaces to FP5-TRANS4M-R and EU-Rail System Pillar, and incorporating a large-scale testing phase of DAC pioneer trains before embarking on a fully fledged DAC roll-out.

DAC General Master Plan 02

- The refined EDDP programme planning as basis for an exhaustive risk management was delivered and the permanent coordination with FP5-TRANS4M-R was done individually and via regular reports in the EDDP meeting boards. Regular alignment meetings took place between the different bodies and, in coordination with the EU-Rail JU, with ERA and EC. The alliances with the European industrial to ensure a successful modal shift was mainly covered by the DAC stakeholder management activities and the management of the interfaces to related EDDP work streams (e.g. EDDP PB, FP5 advisory/ "sounding" boards) including interfaces to other DAC-related EU-Rail JU activities (e.g. System Pillar) and EC and ERA were ensured by setting up regular exchange meetings.

- On top, DACcord has set-up started managing a programme risk and deviation management plan, where appropriate mitigating/countermeasures for the implementing actions are proposed if needed and which are regularly reported in the EDDP PB and SB meetings.

- The impact the DACcord project has made so far (through working in the given EDDP structure) in the EU Freight Railway Sector and the EU institutional environment is considerable. From the shaping of the various outputs such as the DAC General Master Plan and the related multi-annual programme planning to the refining of the DAC migration roadmap, the definition of the DAC Basic Package, the proposal for a possible deployment management entity and funding/financing mechanisms, the drafting of a stakeholder management plan and the broad variety of communication/dissemination activities that have positioned the DAC programme as one of the most relevant R & I initiatives currently ongoing at European level. The above has been complemented by the upcoming planning of the so-called pioneer trains, an integral part of the Master Plan towards supporting DAC full implementation.

ESEP4Freight

The main objective of ESEP4Freight project is to develop a Web platform that will enable the view of available rail freight services across Europe using an interactive map. This platform will be a user friendly tool that will enable the access of open, high-quality information that will promote the shift towards the freight transport by rail.

Progress and results achieved in 2024

- The project has achieved the identification of KPIs, an assessment of emerging technologies and modal share analysis and data collection, specifications for the implementation of blockchain technologies and smart contracts, as well as the analysis of the current contractual and legal framework, with recommendations for improvement.

SYMBIOSIS

The SYMBIOSIS ("Systemic Mobilisation for Joint Biodiversity and Infrastructure") project is an interdisciplinary initiative in biodiversity, aligning with the United Nation's vision for responsible land use and the European Green Deal and aims at building a community of practice between transport infrastructure, energy distribution and production, and biodiversity, while addressing the role of strategic planning in climate change and building resilient infrastructure. The project offers a holistic approach integrating biodiversity considerations through the entire lifecycle of infrastructure projects.

The project will introduce an impact assessment tool for linear infrastructure and promote digitalisation, contributing to a unified European biodiversity baseline through standardised data collection, monitoring and mapping in transport and energy projects. Committed to nature-based solutions for climate-resilient infrastructure, SYMBIOSIS establishes a methodology contributing to the "theory of change", guiding decisions, and facilitating information exchange for "no net loss" and "net gain" biodiversity objectives. It will provide guidance for regulatory changes in biodiversity standardisation globally, as well as recommendations for biodiversity-related research and innovation, guiding decision-makers and investors on pathways leading to a sustainable, biodiverse future.

Progress and results achieved in 2024

The project started on the 1st of October 2024.

- The project has successfully initiated its activities in 2024 with the organisation of the Kick off meeting that facilitated open dialogue among consortium members and external stakeholders, focusing on harmonized habitat management, bridging biodiversity knowledge gaps, and fostering cross-sector collaboration. Additionally, a structured plan for stakeholders mapping, engagement mechanisms, role definitions, and Advisory Board selection has been developed. A clear organizational strategy is also in place to optimise the Advisory Board's effectiveness.

- Data collection for Environmental Impact Assessment case studies from 2021–2024 has commenced and efforts are being made to evaluate the inclusion of raw data from previous project surveys to avoid duplication.

QuieterRail

The main goal of Quieter4Rail project is to to introduce a step change in predicting and mapping railway noise and vibration, in the acceptance testing of rolling stock and in promoting cost-effective noise mitigation. The key activities are:

- Development of squeal and flange noise models and improving the EU-CNOSSOS curve noise factor based on achieved results.
- Creation of a virtual test method for noise from freight wagons and gathering information on noise from new propulsion technology.

- Development of guidelines and a data analysis tool for cost-effective noise mitigation and provide an open-source tool for optimizing the entire track system, considering life cycle costs, noise and vibration.
- Improve the prediction capabilities for holistic ground vibration impact by extending the hybrid vibration prediction tool developed in SILVARSTAR with new simulation capabilities and complementary experimental data.

Progress and results achieved in 2024

The project started on the 1st of October 2024.

- Following the kick-off meeting, various work packages have advanced , with key achievements including the establishment of necessary input data for modelling, defining measurement set-up for squeal noise in curves, and improving transposition methodologies.
- A survey on new propulsion technologies in Europe is conducted, and on-board roughness measurements and rail grinding were evaluated. Track optimization activities identified Advisory Board members and a proposal for ground vibration impact models was made.
- Development of a hybrid ground vibration prediction tool began, focusing on a new cloud-based application to replace the desktop version application developed in the S2R SILVARSTAR project.

DACFIT

The main objectives of DACFIT is to provide a quantitative and technical analysis of vehicle data with detailed examination of retrofitting processes, evaluation of European workshop infrastructure/capacity for retrofitting in order to develop a comprehensive retrofitting strategy and integrated plan

Progress and results achieved in 2024

The project started its activities on 15th October 2024.

- Since the start, the Project has focused on several key areas related to the quantitative and technical analysis of vehicle data, the detailed examination of retrofitting processes, and the evaluation of European workshop infrastructure for retrofitting with the goal to develop a comprehensive retrofitting strategy, culminating in an integrated plan where all collected data converges. To support this, a Decision Support System (DSS) is being developed. During the first phase, the Project is collecting vehicle data for locomotives, wagons, and DAC couplers. Additionally, a preliminary draft of the functional requirements for the DSS has also been prepared and is currently being discussed.
- The Project has already organised a workshop to conduct an installation test of DACs from four different manufacturers. This involved testing how the couplings were installed on wagons by four separate teams (each with two workers) and focused on: Duration and time recording, sstablishing a time frame for installation, standardisation for future test repetition, and assessing capacity demands.

Nexus

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

Progress and results achieved in 2024

The project started on 1st October 2024.

- The NEXUS project has successfully initiated its activities in 2024, setting a strong foundation for its objectives with the organisation of the kick-off meeting and two steering committees. Additionally, the project developed the surveys for passengers and metro operators that will be used to gather requirements for the future Models for metro adaptability analysis, a train control feasibility study and AI and Data Science implementation in Metro Operation.

XCROSS

The main goal of the XCross project is to enhance the monitoring and inspection of railway crossing surface profiles. Key activities include:

- Developing handheld 3D laser scanning and computer vision techniques for fast, accurate, and repeatable crossing surface measurements.
- Creating digital twins of crossings to optimize geometry profiles using advanced strategies, with lifecycle costs as a key consideration.
- Developing Augmented Reality (AR) and 3D printing technologies to provide virtual and physical visualization guides for on-site procedures.

Progress and results achieved in 2024

The project started its activities on 1st October 2024.

- The XCross project has successfully initiated its activities in 2024, setting a strong foundation for its objectives. The kick-off meeting and first workshop (technical discussions with RET and ProRail welders about practical welding and grinding of railway turnouts) have facilitated technical knowledge exchange and stakeholder engagement. The consortium is well-positioned to advance its mission of improving railway crossing maintenance and lifecycle cost management in the coming months.

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 ten PhD positions. The project aligns with the goals of EU-RAIL Joint Undertaking (EU-Rail) and industry partners. Key activities include:

- Developing a research plan for each PhD position, aiming to submit at least two peer-reviewed journal papers per position.
- Covering a wide range of areas such as decarbonization, gender equality, accessibility for individuals with intellectual disabilities, education methods, urban logistics, night train operations, dynamic stability over bridges, safety-relevant communication systems, societal KPIs, accessibility and ICT platforms for interoperability.

By expanding the Academics4Rail project and involving major European rail companies and academia, the project seeks to strengthen research and innovation capabilities in the European railway sector.

Progress and results achieved in 2024

The project started its activities on 1st October 2024.

- The PhDs EU-Rail project has progressed as planned in 2024. The first achievement was the appointment of ten PhD candidates who started their preliminary research activities. Simultaneously, a guidebook for current and future PhDs students in railway research was being finalized, covering key topics and aiming to provide comprehensive guidance and support to PhD students, making this project a significant and impactful contribution to the field.

1.3. Calls for proposals, grant information and other funded actions

1.3.1. Grants

Considering the annual budget availabilities and the EU-Rail Multi-Annual Work Programme and Work Programme 2024, the EU-Rail R&I activities are implemented through combined and interdependent multi-annual Projects. This structured interdependence of the EU-Rail Projects is based on the mutually integrated System and Innovation Pillars, complemented by the work of the Deployment Group.

In 2024, the Europe's Rail Joint Undertaking launched one call for proposals, but first carried out the evaluation of the call launched still in 2023. This call (HORIZON-JU-ER-2023-01) was launched on 4 October 2023 following the adoption of the JU's Multi-Annual Work Programme[22] and Work Programme 2023-2024[23] by the Governing Board on 30 November 2022. This call for proposals covered two destinations (Flagship Areas) in accordance with Annex VII of the WP 2023-2024. It was open to all eligible entities in accordance with the eligibility criteria set out in the Horizon Europe General Annexes, in particular General Annex B[24].

The respective Decision of the JU GB approving the results of the call was adopted on 9 April 2024[25].

The following tables summarise the amounts and topics related to the call:

Call	Topic Code	Type of Action	Expected EU contribution
HORIZON-JU-ER-2023-01	HORIZON-ER-JU-2023-FA1-SESAR	IA	5.0
HORIZON-JU-ER-2023-01	HORIZON-ER-JU-2023-EXPLR-01	RIA	4.1
HORIZON-JU-ER-2023-01	HORIZON-ER-JU-2023-EXPLR-02	RIA	3.1
HORIZON-JU-ER-2023-01	HORIZON-ER-JU-2023-EXPLR-03	CSA	2.8
HORIZON-JU-ER-2023-01	HORIZON-ER-JU-2023-EXPLR-04	RIA	2.7
HORIZON-JU-ER-2023-01	HORIZON-ER-JU-2023-EXPLR-05	RIA	2.0
HORIZON-JU-ER-2023-01	HORIZON-ER-JU-2023-EXPLR-06	CSA	1.5

Topic Code	Topic Description	Type of Action
HORIZON-ER-JU-2023-FA1-SESAR	EU-RAIL – SESAR SYNERGY: INTEGRATED AIR AND RAIL NETWORK BACKBONE FOR A SUSTAINABLE AND ENERGY-EFFICIENT MULTIMODAL TRANSPORT SYSTEM	IA
HORIZON-ER-JU-2023-EXPLR-01	NOISE AND VIBRATIONS	RIA
HORIZON-ER-JU-2023-EXPLR-02	FUTURE METRO SYSTEMS	RIA
HORIZON-ER-JU-2023-EXPLR-03	BIODIVERSITY	CSA
HORIZON-ER-JU-2023-EXPLR-04	DISRUPTIVE ASSETS MANAGEMENT SOLUTIONS, INCLUDING URBAN USE CASES	RIA
HORIZON-ER-JU-2023-EXPLR-05	EXTENDING THE RAIL NETWORK OF PHDS	RIA
HORIZON-ER-JU-2023-EXPLR-06	DAC FLEET RETROFITTING AND RETROFIT CAPACITY PLAN	CSA

The total number of proposals received in response to the call for proposals was 24:

22 https://rail-research.europa.eu/wp-content/uploads/2022/03/EURAIL_MAWP_final.pdf.
23 https://rail-research.europa.eu/wp-content/uploads/2023/12/GB-Decision_15_Annex_WP23_24_Amendment-no.2.pdf
24 wp-13-general-annexes_horizon-2023-2024_en.pdf
25 Decision N°6/2024 approving the list of actions selected for funding under EU-Rail Call for proposals HORIZON-ER-JU-2023-01

Call	Topic	Type of Action	Number of proposals received
HORIZON-JU-ER-2023-01	HORIZON-ER-JU-2023-FA1-SESAR	IA	1
HORIZON-JU-ER-2023-01	HORIZON-ER-JU-2023-EXPLR-01	RIA	4
HORIZON-JU-ER-2023-01	HORIZON-ER-JU-2023-EXPLR-02	RIA	4
HORIZON-JU-ER-2023-01	HORIZON-ER-JU-2023-EXPLR-03	CSA	3
HORIZON-JU-ER-2023-01	HORIZON-ER-JU-2023-EXPLR-04	RIA	7
HORIZON-JU-ER-2023-01	HORIZON-ER-JU-2023-EXPLR-05	RIA	2
HORIZON-JU-ER-2023-01	HORIZON-ER-JU-2023-EXPLR-06	CSA	3

A total of 210 participants were involved in the 21 eligible proposals submitted to this call, reflecting respectively on the ten topics open to them. Following the evaluation, 110 participants (52%) are involved in the 7 proposals considered for funding.

The total EU-Rail contribution requested by all the submitted proposals amounted to EUR 66,57 million compared to EUR 21,2 million available for funding:

Call	Grant Requested	Expected EU contribution
HORIZON-JU-ER-2023-01	60.9	21.2

Following the GB Decision N°6/2024 of 9 April 2024, grants were proposed to be awarded resulting in the amounts provided below:

Call	Total Project Cost	EU-Rail Funding	IKOP	Other contribution to R&I
HORIZON-JU-ER-2023-01	62.3	21.2	0.4	2.1

Following the GAP phase, the value of activities resulting from this call to be performed in the coming period in respect to the signed grants corresponds to EUR 18,6 million of eligible costs, and EUR 24,6 million of total project value, that will be funded by EU-Rail up to EUR 18,6 million.

On 25 January 2024, the JU launched the fourth call for proposals (HORIZON-ER-JU-2024-01), following the adoption of the JU's Work Programme 2024[26] by the Governing Board on 5 December 2023. This call for proposals covered three destinations (Flagship Areas) in accordance with Annex VII of the WP 2024. It was open to all eligible entities in accordance with the eligibility criteria set out in the Horizon Europe General Annexes, in particular General Annex B[27].

The respective Decision of the JU GB approving the results of the call was adopted on 17 July 2024[28]. The number of proposals submitted where 3, the number of evaluated proposals was also 3 and the three of them were retained for funding.

The following tables summarise the amounts and topics related to the call:

[26] https://rail-research.europa.eu/wp-content/uploads/2023/12/GB-Decision_15_Annex_WP23_24_Amendment-no.2.pdf
[27] wp-13-general-annexes_horizon-2023-2024_en.pdf
[28] Decision N°13/2024 approving the ranked lists of innovation actions selected for funding under the Europe's Rail call for proposals HORIZON-ER-JU-2024-01

Call	Topic Code	Type of Action	Expected EU contribution
HORIZON-ER-JU-2024-01	HORIZON-ER-JU-2024-FA2-SNS	IA	13.5
HORIZON-ER-JU-2024-01	HORIZON-ER-JU-2024-FA5	IA	5.9
HORIZON-ER-JU-2024-01	HORIZON-ER-JU-2024-FA7	RIA	2.3

Topic Code	Topic Description	Type of Action
HORIZON-ER-JU-2024-FA2-SNS	EU-RAIL – SNS SYNERGY: DIGITAL & AUTOMATED TESTING AND OPERATIONAL VALIDATION OF THE NEXT EU RAIL COMMUNICATION SYSTEM	IA
HORIZON-ER-JU-2024-FA5	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	IA
HORIZON-ER-JU-2024-FA7	HYPERLOOP – ROADMAP TOWARDS INDUSTRIALISATION AND HARMONIZED IMPLEMENTABLE CONCEPT	RIA

The total number of proposals received in response to the call for proposals was 3:

Call	Topic	Type of Action	Number of proposals received
HORIZON-ER-JU-2024-01	HORIZON-ER-JU-2024-FA2-SNS	IA	1
HORIZON-ER-JU-2024-01	HORIZON-ER-JU-2024-FA5	IA	1
HORIZON-ER-JU-2024-01	HORIZON-ER-JU-2024-FA7	RIA	1

A total of 88 participants were involved in the 3 eligible proposals submitted to this call, reflecting respectively on the ten topics open to them. Following the evaluation, all of the participants (100%) are involved in the 3 proposals considered for funding.

The total EU-Rail contribution requested by all the submitted proposals amounted to EUR 21,7 million compared to EUR 21,7 million available for funding:

Call	Grant Requested	Expected EU contribution
HORIZON-ER-JU-2024-01	21.7	21.7

Following the GB Decision N°13/2024 of 17 July 2024, grants were proposed to be awarded resulting in the amounts provided below:

Call	Total Project Cost	EU-Rail Funding	IKOP	Other contribution to R&I
HORIZON-ER-JU-2024-01	34.6	21.7	8.1	1.7

Following the GAP phase, the value of activities resulting from this call to be performed in the coming period in respect to the signed grants corresponds to EUR 29,1 million of eligible costs, and EUR 31,6 million of total project value, that will be funded by EU-Rail up to EUR 29,1 million.

1.3.2. Operational tenders and contracts

With regard to the implementation of procurement activities, the JU has complied with the principles of the EU Financial Regulation and the guidance provided in the European Commission Procurement Vademecum. This resulted in the implementation of activities obtaining the best value for money.

The values established for the different procurement procedures, which are below any materiality level considering the total value of the R&I activities and the Programme, result from the collective knowledge of involved staff and their experience in previous private and public organizations.[29]

In 2024, the JU did not conclude open tender procedures. EU-RAIL published on 06/12/2024 an open tender "Locomotive fleet retrofit and engineering solutions for DAC (and ERTMS)" with a deadline for receipt of tenders on 27/02/2025. The tender procedure is expected to be concluded in July 2025

In accordance with Article 43(4) of the EU-Rail Financial Rules and as announced in the Europe's Rail Work Programme 2024 (amendment n°2), in 2024 EU-Rail renewed six direct contracts for services with EU-Rail private Founding Members to avail EU-Rail with the services of Flagship Project Managers with a total value of EUR 900.000 (six contracts)The EU-Rail Financial Rules allow to conclude direct contracts with EU-Rail private Founding Members "*without having recourse to a public procurement procedure".* To preserve the principle of sound financial management and the legality and regularity of the procedure, EU-Rail implemented a light "negotiated procedure" with the EU-Rail private Founding Members and applied by analogy the procurement negotiated procedure for very low value contract (Point 14 FR Annex 1 of the EU Financial Regulation).

In accordance with the Work Programme 2024 (amendment n°2), the implementation of the following framework contracts continued in 2024:

- Europe's Rail System Pillar. Implementation of framework services contracts concluded on 12/07/2022 with "System Pillar Consortium" (for the 3 lots) for the provision of services to EU-Rail in the fields of System Pillar core group (lot 1), System Pillar expertise (lot 2) and CCS TSI maintenance activities (lot 3).
- Strategic support to the EU-Rail and other impact assessments, evaluations, foresight, analyses and studies. Implementation of framework services contracts concluded on 03/02/2021 for the provision of services to the EU-RAIL in the fields of strategy advice (LOT1), support to programme management (LOT 2) and legal assistance (LOT3) with companies Ernst&Young, Deloitte Consulting and consortium Daldewolf/Privanot respectivelly[30].
- Passenger perspective in rail transformation. Implementation of a framework contracts for services concluded on 18/12/2023 with the The European Passengers' Federation (EPF).

In accordance with Article 15 (Principle of transparency) of the EU-Rail Financial Rules the JU shall make available on its internet site no later than 30 June of the following financial year information on the recipients of funds deriving from its budget, including procurement contracts. In addition, as stated in point 3.3 of Annex I to the Financial Regulation 2018/1046 (which applies to the JU), EU-Rail, as a contracting authority, shall publish a list of contracts on its website no later than 30 June of the following financial year for specific contracts and order forms implementing a framework contract. The EU-Rail recipients of Funds and Annual List of Specific Contracts are published at https://rail-research.europa.eu/participate/recipients-eu-rail-funds/.

[29] Also in answer to point 15 of Discharge 2016 of EP, reference P8_TA-PROV(2018)0173.

[30] Taken into consideration the nature of the services covered by LOT 2 and LOT 3, the implementation of those Framework contracts is covered by the administrative expenditure (see section 2.5- Administrative Procurement and contracts).

1.4. Evaluation procedures and outcomes

EU-Rail launched 1 call for proposals in 2024 but also evaluated the call launched in 2023.

The evaluation of the call 2023 was carried out between 9 February and 14 March 2024. The evaluation procedure was performed remotely, making use of digital web-conferencing tools. However, this represented no issue to the proper performance of the evaluation process.

The evaluation of proposals was carried out with the assistance of 18 independent technical experts (4 of them financial experts), and 4 additional experts contracted as recorders. Evaluations were conducted in four panels, with the representatives from the Commission (DG MOVE, DG RTD), from ERA and SESAR JU having been invited to be present at the panel's meetings as observers. An independent observer was also appointed in accordance with the procedures laid down in the Guide for proposal submission and evaluation of the Horizon Europe grants. The independent observer's role was to observe and offer independent advice on the conduct and fairness of the evaluation sessions, on the application of the evaluation criteria and on ways to improve processes.

In selecting the independent external experts, the primary objective was to ensure a high level of skills, experience, and knowledge in the areas of the call (including project management, innovation, exploitation, dissemination and communication). Under these conditions, special attention was given to achieve an appropriate balance composition of the panel in terms of various skills, experience, and knowledge, geographical diversity and gender. The composition was the following:

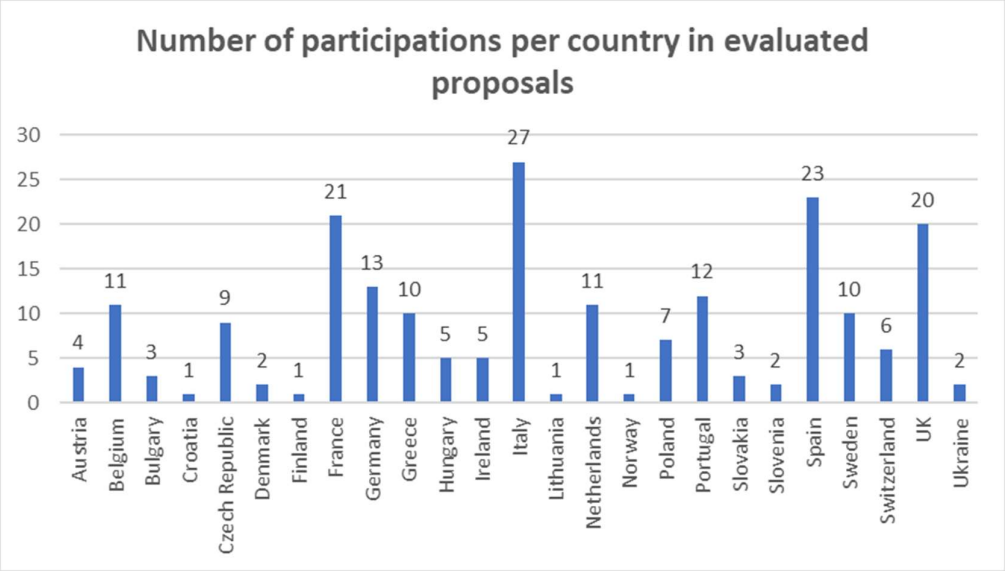
- Gender balance: 9 men (43%), 12 women (57%);
- Regional balance: representatives from 12 different countries.

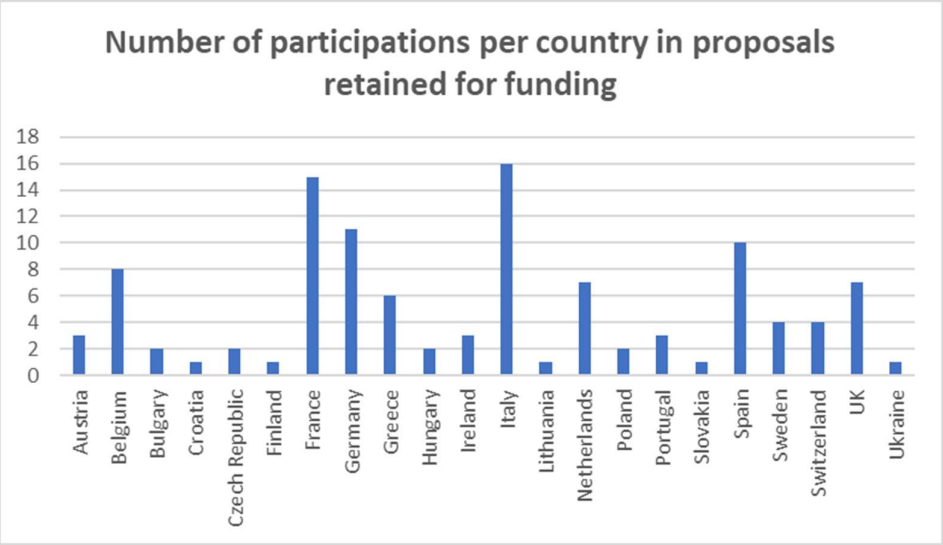
The consensus meetings of the experts were organised remotely during the period 8 – 14 March 2024. A briefing was held on 9 February 2024, in which the EU-Rail representative provided relevant information related to the consensus phase to the independent experts, such as the specificities of the EU-Rail calls for proposals, the confidentiality requirements, or the experts' obligations regarding potential conflicts of interests.

The total number of proposals submitted was twenty four, twenty one of them were evaluated. Seven proposals were retained for funding representing a success rate of 63,3% out of the admissible and eligible proposals.

There were 41 SMEs participating in the call with a success rate of 51%, 21 of them having their proposal retained for funding. Participations of SMEs represented 19% within the overall proposals evaluated and 19,1% within the proposals retained for funding.

From a geographical perspective, there were participants to the call coming from 25 countries, there were participants from 21 EU Member States, 2 participants from Associated Countries, UK and one from a third country. Among the 110 participations in proposals retained for funding, 19 EU Member States, 1 participant from an Associated Country, UK and 1 from a third country are represented.





Regarding the call launched in 2024, the evaluation was carried out between 7 and 27 June 2024. The evaluation procedure was performed remotely, making use of digital web-conferencing tools. However, this represented no issue to the proper performance of the evaluation process.

The evaluation of proposals was carried out with the assistance of 12 independent technical experts (2 of them financial experts), and 2 additional experts contracted as recorders. Evaluations were conducted in two panels, with the representatives from the Commission (DG MOVE, DG RTD), from ERA and SNS JU having been invited to be present at the panel's meetings as observers. An independent observer was also appointed in accordance with the procedures laid down in the Guide for proposal submission and evaluation of the Horizon Europe grants. The independent observer's role was to observe and offer independent advice on the conduct and fairness of the evaluation sessions, on the application of the evaluation criteria and on ways to improve processes.

In selecting the independent external experts, the primary objective was to ensure a high level of skills, experience, and knowledge in the areas of the call (including project management, innovation, exploitation, dissemination and communication). Under these conditions, special attention was given to achieve an appropriate balance composition of the panel in terms of various skills, experience, and knowledge, geographical diversity and gender. The composition was the following:

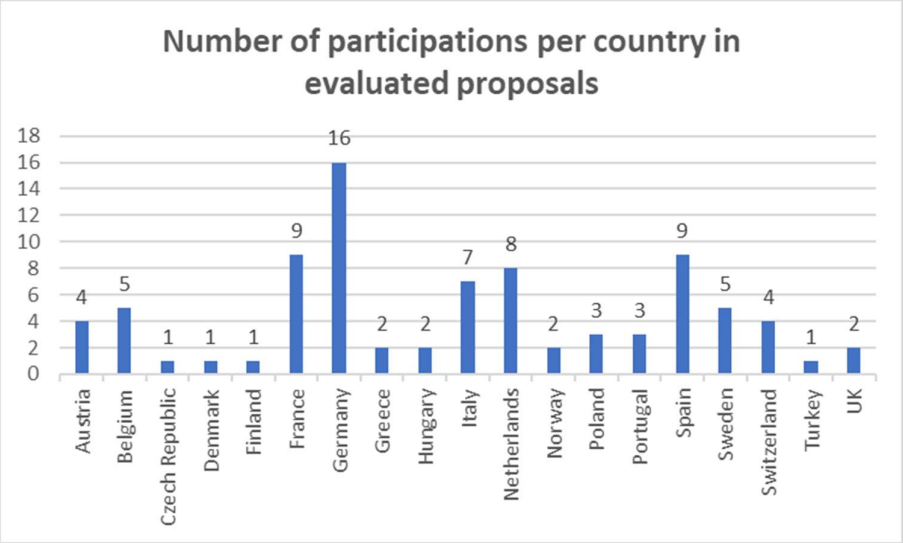
- Gender balance: 10 men (71%), 4 women (29%);
- Regional balance: representatives from 9 different countries.

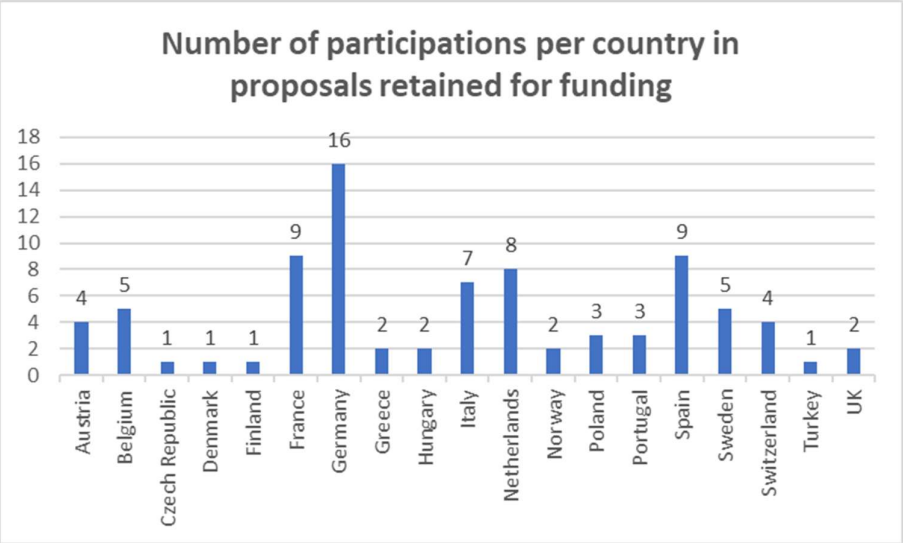
The consensus meetings of the experts were organised remotely during the period 24 – 25 June 2024.A briefing was held on 7 June 2024, in which the EU-Rail representative provided relevant information related to the consensus phase to the independent experts, such as the specificities of the EU-Rail calls for proposals, the confidentiality requirements, or the experts' obligations regarding potential conflicts of interests.

The total number of proposals submitted was three, all of them were evaluated and retained for funding representing a success rate of 100% out of the admissible and eligible proposals.

There were 12 SMEs participating in the call with a success rate of 100%, since all of them had their proposal retained for funding. Participations of SMEs represented 14% within the overall proposals evaluated and 14% within the proposals retained for funding.

From a geographical perspective, there were participants to the call coming from 26 countries, there were participants from 15 EU Member States, 3 associated countries and 1 third country. Same figures for the proposals retained for funding, since all the proposals submitted were awarded.

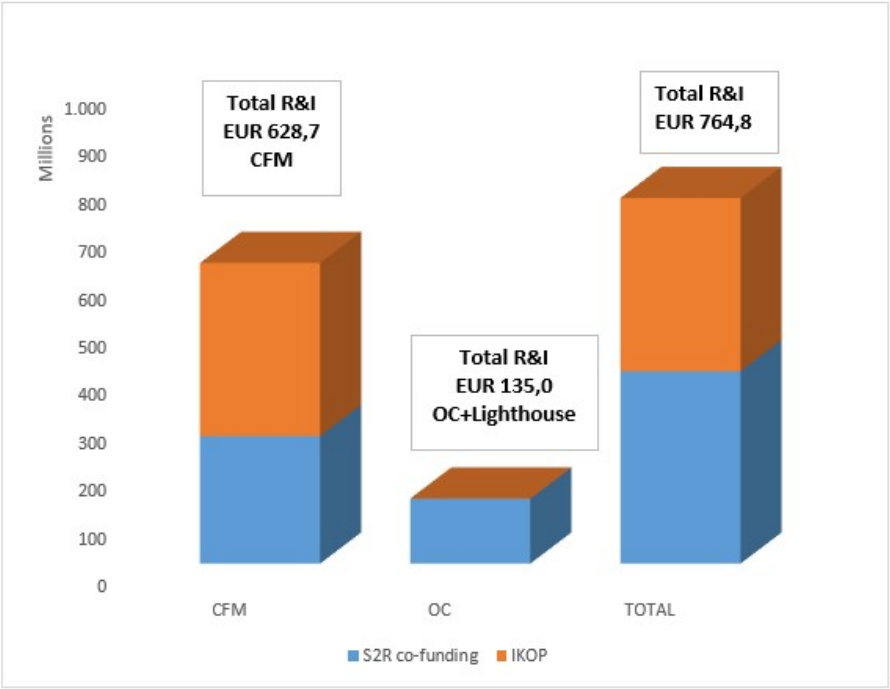




1.5. Follow-up activities linked to past calls

For the Shift2Rail Programme, the year 2024 mainly consisted in ensuring the proper closing of the programme. As by the end of 2021, the JU had signed a total of 101 grant agreements since its autonomy in 2016. The R&I activities performed in the Programme reached EUR 764.8 million (including Lighthouse Projects as part of the S2R initiative), of which EUR 628,7 million performed by the S2R Members with a funding made available by the JU up to a maximum of EUR 266,6 million.

While in accordance with the respective Membership Agreements the S2R Other Members agreed to limit their request for funding to 44,44% of the Total Project Costs, the OC topics are co-funded at the rates established in the H2020 Rules of participation.



It is important to mention that the S2R R&I exceeded the objectives as described in the JU Council Regulations as confirmed with the Programme closure in 2024.

On 31 December 2024, all projects had finalised their administrative activities and the last payments were completed by year end. The full breakdown of the projects per IP is the following:

IP1: Cost-efficient and Reliable Trains, including high-capacity trains and high-speed trains

Project Title	Call Reference	Period	Project Value (signed GA)
CARBODIN	H2020-S2RJU-OC-2019	01/12/2019 to 28/02/2022	3.334.367,55 €
Connecta	H2020-S2RJU-CFM-2016	01/09/2016 to 30/09/2018	12.333.045,70 €
CONNECTA-2	H2020-S2RJU-CFM-2018	01/10/2018 to 31/07/2021	9.687.622,39 €
CONNECTA-3	H2020-S2RJU-CFM-2020	01/12/2020 to 30/11/2023	8.973.662,69 €
Gearbodies	H2020-S2RJU-OC-2020	01/12/2020 to 30/06/2023	2.419.968,75 €
Mat4Rail	H2020-S2RJU-OC-2017	01/10/2017 to 30/09/2019	3.495.216,25 €
NEXTGEAR	H2020-S2RJU-OC-2019	01/12/2019 to 28/02/2022	2.573.877,50 €
PINTA	H2020-S2RJU-CFM-2016	01/09/2016 to 31/12/2018	28.855.184,05 €
PINTA2	H2020-S2RJU-CFM-2018	01/09/2018 to 28/02/2021	28.534.183,73 €
PINTA3	H2020-S2RJU-CFM-2020	01/12/2020 to 31/05/2023	19.446.251,31 €
PIVOT	H2020-S2RJU-CFM-2017	01/10/2017 to 31/12/2019	17.432.048,20 €
PIVOT2	H2020-S2RJU-CFM-2019	01/10/2019 to 30/06/2023	41.587.474,19 €
RECET4Rail	H2020-S2RJU-OC-2020	01/12/2020 to 30/09/2023	2.300.036,25 €
RUN2Rail	H2020-S2RJU-OC-2017	01/09/2017 to 3009/2023	2.732.463,75 €
SAFE4RAIL	H2020-S2RJU-OC-2016	01/10/2016 to 31/12/2018	6.681.211,25 €
Safe4RAIL-2	H2020-S2RJU-OC-2018	01/10/2018 to 31/07/2021	3.991.632,50 €
Safe4Rail-3	H2020-S2RJU-OC-2020	01/12/2020 to 30/11/2023	4.585.831,39 €

IP2: Advanced Traffic Management & Control System

Project Title	Call Reference	Period	Project Value (signed GA)
4SECURAIL	H2020-S2RJU-OC-2019	01/12/2019 to 30/11/2021	549.875,00 €
AB4Rail	H2020-S2RJU-OC-2020	01/01/2021 to 31/12/2022	349.926,25 €
ASTRail	H2020-S2RJU-OC-2017	01/09/2017 to 31/10/2019	1.797.307,50 €
CYRail	H2020-S2RJU-OC-2015-01-2	01/10/2016 to 30/09/2018	1.498.150,00 €
EMULRADIO4RAIL	H2020-S2RJU-OC-2018	01/12/2018 to 31/12/2020	748.097,50 €
ETALON	H2020-S2RJU-OC-2017	01/09/2017 to 29/02/2020	1.699.998,75 €
GATE4RAIL	H2020-S2RJU-OC-2018	01/12/2018 to 28/02/2021	1.019.993,75 €
MISTRAL	H2020-S2RJU-OC-2015-01-2	01/11/2016 to 31/10/2018	499.282,50 €
MOVINGRAIL	H2020-S2RJU-OC-2018	01/12/2018 to 31/12/2020	1.299.135,00 €

OPTIMA	H2020-S2RJU-OC-2019	01/12/2019 to 28/02/2023	2.235.998,50 €
PERFORMINGRAIL	H2020-S2RJU-OC-2020	01/12/2020 to 30/06/2023	1.335.358,75 €
VITE	H2020-S2RJU-OC-2015-01-2	01/11/2016 to 31/12/2018	947.756,88 €
X2Rail-1	H2020-S2RJU-CFM-2015-01-1	01/09/2016 to 30/06/2021	40.878.154,47 €
X2RAIL-2	H2020-S2RJU-CFM-2017	01/09/2017 to 30/04/2021	28.833.201,91 €
X2Rail-3	H2020-S2RJU-CFM-2018	01/12/2018 to 30/11/2021	38.728.459,46 €
X2Rail-4	H2020-S2RJU-CFM-2019	01/12/2019 to 28/02/2023	40.371.491,75 €
X2Rail-5	H2020-S2RJU-CFM-2020	01/12/2020 to 31/05/2023	35.481.979,44 €

IP3: Cost-efficient, Sustainable and Reliable High-Capacity Infrastructure

Project Title	Call Reference	Period	Project Value (signed GA)
Assets4Rail	H2020-S2RJU-OC-2018	01/12/2018 to 31/12/2021	5.506.631,25 €
DAYDREAMS	H2020-S2RJU-OC-2020	01/12/2020 to 31/05/2023	1.709.875,00 €
FAIR Stations	H2020-S2RJU-OC-2017	01/09/2017 to 31/12/2019	1.199.875,00 €
FUNDRES	H2020-S2RJU-OC-2019	01/12/2019 to 30/11/2021	749.540,00 €
IN2DREAMS	H2020-S2RJU-OC-2017	01/09/2017 to 31/10/2019	2.195.715,00 €
IN2Smart	H2020-S2RJU-CFM-2016-01-1	01/09/2016 to 31/10/2019	16.405.562,56 €
IN2SMART2	H2020-S2RJU-CFM-2019	01/12/2019 to 30/11/2022	23.091.203,52 €
IN2STEMPO	H2020-S2RJU-CFM-2017	01/09/2017 to 31/08/2022	13.439.977,32 €
IN2Track	H2020-S2RJU-CFM-2016-01-1	01/09/2016 to 30/04/2019	6.324.052,15 €
IN2TRACK2	H2020-S2RJU-CFM-2018	01/11/2018 to 30/04/2021	29.676.014,82 €
IN2TRACK3	H2020-S2RJU-CFM-2020	01/01/2021 to 31/12/2023	27.329.170,30 €
IN2ZONE	H2020-S2RJU-OC-2020	01/12/2020 to 31/05/2023	1.349.973,75 €
MOMIT	H2020-S2RJU-OC-2017	01/09/2017 to 31/10/2019	599.172,00 €
S-CODE	H2020-S2RJU-OC-2016-01-2	01/11/2016 to 31/10/2019	4.999.771,25 €
STREAM	H2020-S2RJU-OC-2020	01/12/2020 to 31/05/2023	2.700.000,00 €

IP4: IT Solution for Attractive Railways Services

Project Title	Call Reference	Period	Project Value (signed GA)
ATTRACkTIVE	H2020-S2RJU-CFM-2015-01-1	01/09/2016 to 31/05/2019	5.256.030,00 €
Co-Active	H2020-S2RJU-CFM-2015-01-1	01/09/2016 to 31/05/2019	7.621.915,46 €
COHESIVE	H2020-S2RJU-CFM-2017	01/09/2017 to 30/06/2022	4.039.491,60 €
CONNECTIVE	H2020-S2RJU-CFM-2017	01/09/2017 to 31/12/2022	7.906.243,25 €
ExtenSive	H2020-S2RJU-CFM-2020	01/12/2020 to 30/06/2023	11.139.724,10 €
GoF4R	H2020-S2RJU-OC-2016-01-2	01/11/2016 to 31/10/2018	2.000.000,00 €

IP4MaaS	H2020-S2RJU-OC-2020	01/12/2020 to 31/05/2023	2.507.081,25 €
MaaSive	H2020-S2RJU-CFM-2018	01/11/2018 to 31/05/2021	11.692.236,25 €
My-TRAC	H2020-S2RJU-OC-2017	01/09/2017 to 31/12/2020	3.494.476,25 €
RIDE2RAIL	H2020-S2RJU-OC-2019	01/12/2019 to 30/11/2022	2.999.993,75 €
Shift2MaaS	H2020-S2RJU-OC-2018	01/12/2018 to 30/06/2021	1.492.362,92 €
SPRINT	H2020-S2RJU-OC-2018	01/12/2018 to 28/02/2021	1.999.500,00 €
ST4RT	H2020-S2RJU-OC-2016-01-2	01/11/2016 to 31/10/2018	1.000.000,00 €

IP5: Technologies for Sustainable & Attractive European Freight

Project Title	Call Reference	Period	Project Value (signed GA)
ARCC	H2020-S2RJU-CFM-2015-01-1	01/09/2016 to 30/04/2021	3.669.629,15 €
DACcelerate	H2020-S2RJU-2021	01/06/2021 to 31/12/2022	2.171.998,02 €
DYNAFREIGHT	H2020-S2RJU-OC-2015-01-2	01/11/2016 to 30/06/2018	999.822,50 €
FFL4E	H2020-S2RJU-CFM-2015-01-1	01/09/2016 to 31/07/2019	3.375.017,00 €
FR8HUB	H2020-S2RJU-CFM-2017	01/09/2017 to 28/02/2021	9.900.990,10 €
FR8RAil	H2020-S2RJU-CFM-2015-01-1	01/09/2016 to 31/08/2019	7.826.783,00 €
FR8RAIL II	H2020-S2RJU-CFM-2018	01/05/2018 to 31/07/2021	12.450.389,86 €
FR8RAIL III	H2020-S2RJU-CFM-2019	01/09/2019 to 31/08/2022	13.061.601,13 €
FR8RAIL IV	H2020-S2RJU-CFM-2020	01/07/2020 to 31/03/2023	17.604.533,82 €
INNOWAG	H2020-S2RJU-OC-2015-01-2	01/11/2016 to 30/06/2019	1.500.562,50 €
LOCATE	H2020-S2RJU-OC-2019	01/11/2019 to 30/04/2022	1.499.072,50 €
M2O	H2020-S2RJU-OC-2018	01/12/2018 to 31/12/2020	599.955,00 €
OPTIYARD	H2020-S2RJU-OC-2017	01/10/2017 to 30/09/2019	1.499.900,00 €
SMART	H2020-S2RJU-OC-2015-01-2	01/10/2016 to 30/09/2019	999.598,75 €
SMART2	H2020-S2RJU-OC-2019	01/12/2019 to 30/11/2022	1.708.737,50 €

CCA: Cross Cutting Activities and IPX

Project Title	Call Reference	Period	Project Value (signed GA)
B4CM	H2020-S2RJU-OC-2018	01/12/2018 to 30/11/2022	124.951,25 €
Ben[at]rail	H2020-S2RJU-2021	01/10/2021 to 30/06/2022	169.985,00 €
DESTINATE	H2020-S2RJU-OC-2015-01-2	01/11/2016 to 31/10/2018	999.312,50 €
FINE 1	H2020-S2RJU-CFM-2015-01-1	01/09/2016 to 31/10/2019	3.017.281,70 €
FINE-2	H2020-S2RJU-CFM-2019	01/12/2019 to 30/11/2022	8.179.972,67 €
FLEX-RAIL	H2020-S2RJU-OC-2018	01/12/2018 to 30/06/2021	1.099.230,00 €
GoSAFE RAIL	H2020-S2RJU-OC-2015-01-2	01/10/2016 to 30/09/2019	1.298.750,00 €

HYPERNEX	H2020-S2RJU-OC-2020	01/12/2020 to 28/02/2022	250.000,00 €
IMPACT-1	H2020-S2RJU-CFM-2015-01-1	01/09/2016 to 30/04/2018	674.958,83 €
IMPACT-2	H2020-S2RJU-CFM-2017	01/03/2019 to 31/12/2022	7.331.848,37 €
LinX4Rail	H2020-S2RJU-CFM-2019	01/12/2019 to 30/11/2022	5.216.493,89 €
LINX4RAIL2	H2020-S2RJU-CFM-2020	01/12/2020 to 31/05/2023	3.228.828,65 €
MVDC-ERS	H2020-S2RJU-OC-2018	01/12/2018 to 30/04/2022	125.000,00 €
NEAR2050	H2020-S2RJU-OC-2015-01-2	01/10/2016 to 30/04/2018	399.891,25 €
OPEUS	H2020-S2RJU-OC-2015-01-2	01/11/2016 to 31/10/2019	797.130,00 €
Plasa	H2020-S2RJU-CFM-2015-01-1	01/09/2016 to 31/08/2018	786.349,00 €
PLASA-2	H2020-S2RJU-CFM-2018	01/09/2018 to 31/12/2020	1.853.383,79 €
RAILS	H2020-S2RJU-OC-2019	01/12/2019 to 30/06/2023	299.953,75 €
SILVARSTAR	H2020-S2RJU-OC-2020	01/11/2020 to 31/10/2022	949.999,50 €
SMaRTE	H2020-S2RJU-OC-2017	01/09/2017 to 31/10/2019	769.958,75 €
TAURO	H2020-S2RJU-CFM-2020	01/12/2020 to 31/05/2023	4.559.803,03 €
TER4RAIL	H2020-S2RJU-OC-2018	01/12/2018 to 30/11/2020	499.992,50 €
TRANSIT	H2020-S2RJU-OC-2019	01/12/2019 to 30/11/2022	1.308.718,75 €
Translate4Rail	H2020-S2RJU-OC-2019	01/12/2019 to 30/11/2022	248.093,75 €

On 31 December 2024, all 101 S2R projects were closed with final payment executed in 2024 for all the projects listed below (closure date may refer to some administrative reopening after final payment):

Closed Projects related to Call for member topics for S2R JU Members

TOPIC	ACRONYM	TITLE	PROJECT VALUE	GRANT	START DATE	CLOSURE DATE
H2020-S2RJU-CFM-2015-01-1	ARCC	Automated Rail Cargo Consortium: Rail freight automation research activities to boost levels of quality, efficiency, and cost effectiveness in all areas of rail freight operations	5.3	1.5	18/04/2023	15/03/2024
H2020-S2RJU-CFM-2015-01-1	ATTRACKTIVE	Advanced Travel Companion and Tracking Services	5.4	2.2	01/09/2016	21/10/2020
H2020-S2RJU-CFM-2015-01-1	CO-ACTIVE	Co-modal journey re-Accommodation on associated Travel services	7.7	3.4	01/09/2016	18/01/2023
H2020-S2RJU-CFM-2017	COHESIVE	Coherent Setup and Demonstration of Integrated Travel Services	3.8	1.5	26/09/2023	20/10/2023
H2020-S2RJU-CFM-2016-01-1	CONNECTA	Contributing to Shift2Rail's next generation of high Capable and safe TCMS and brakes. Phase 1.	11.5	5	01/09/2016	25/03/2020
H2020-S2RJU-CFM-2018	CONNECTA-2	Contributing to Shift2Rail's next generation of high Capable and safe TCMS. Phase 2.	9.9	4.3	01/10/2018	31/07/2021
H2020-S2RJU-2020	CONNECTA-3	CONtributing to Shift2Rail's NExt generation of high Capable and safe TCMS PhAse 3	8.5	3.9	01/12/2020	08/10/2024

H2020-S2RJU-CFM-2017	CONNECTIVE	Connecting and Analysing the Digital Transport Ecosystem	8	3.5	01/09/2017	16/10/2024
H2020-S2RJU-2020	ExtenSive	Extending the attractiveness of transport for end user and extending IP4 to SaaS solutions.	12.2	5.	01/12/2020	08/10/2024
H2020-S2RJU-CFM-2015-01-1	FFL4E	Future Freight Loco for Europe	3.5	1.4	01/09/2016	25/03/2020
H2020-S2RJU-CFM-2015-01-1	FINE1	Future Freight Loco for Europe	3.2	1.3	01/09/2016	12/04/2021
H2020-S2RJU-CFM-2019	FINE-2	Furthering Improvements in Integrated Mobility Management (I2M), Noise and Vibration, and Energy in Shift2Rail	8.4	3.6	01/12/2019	06/11/2024
H2020-S2RJU-CFM-2017	FR8HUB	Real time information applications and energy efficient solutions for rail freight	9	4.2	27/10/2023	08/12/2023
H2020-S2RJU-CFM-2015-01-1	FR8RAIL	Development of Functional Requirements for Sustainable and Attractive European Rail Freight	10.9	3.3	01/09/2016	14/12/2021
H2020-S2RJU-CFM-2018	FR8RAIL II	Digitalization and Automation of Freight Rail	12.7	5.5	01/05/2018	25/04/2024
H2020-S2RJU-CFM-2019	FR8RAIL III	Smart data-based assets and efficient rail freight operation	13.3	5.8	01/09/2019	23/12/2023
H2020-S2RJU-2020	FR8RAIL IV	Use-centric rail freight innovation for Single European Railway Area.	19	7.8	01/07/2020	07/12/2024
H2020-S2RJU-CFM-2015-01-1	IMPACT-1	Indicator Monitoring for a new railway Paradigm in seamlessly integrated Cross modal Transport chains – Phase 1	1.2	0.3	01/09/2016	05/07/2021
H2020-S2RJU-CFM-2017	IMPACT-2	Indicator Monitoring for a new railway Paradigm in seamlessly integrated Cross modal Transport chains – Phase 2	7.5	3.1	07/08/2023	14/11/2023
H2020-S2RJU-CFM-2016-01-1	IN2SMART	Intelligent Innovative Smart Maintenance of Assets by integrated Technologies	15.7	7	01/09/2016	26/04/2021
H2020-S2RJU-CFM-2019	IN2SMART2	Intelligent Innovative Smart Maintenance of Assets by integRated Technologies 2	22.9	10.1	01/12/2019	28/08/2024
H2020-S2RJU-CFM-2017	IN2STEMPO	Innovative Solutions in Future Stations, Energy Metering and Power Supply	12.2	6	01/09/2017	13/12/2024
H2020-S2RJU-CFM-2016-01-1	In2Track	Research into enhanced tracks, switches, and structures	5.3	2.3	01/09/2016	03/10/2022
H2020-S2RJU-CFM-2018	IN2TRACK2	Research into enhanced track and switch and crossing system 2	28.2	13.2	01/11/2018	25/11/2024
H2020-S2RJU-2020	IN2TRACK3	IN2TRACK3	27.2	11.1	01/01/2021	23/11/2024
H2020-S2RJU-CFM-2019	LINX4RAIL	System architecture and Conceptual Data Model for railway, common data dictionary and global system modelling specifications	4.3	2	14/11/2023	17/12/2023

H2020-S2RJU-CFM-2020	LINX4RAIL2	System architecture and conceptual data model for railway, common data dictionary and global system modelling specifications	2.7	1.2	01/12/2020	30/01/2024
H2020-S2RJU-CFM-2018	MaaSive	Passenger service platform specifications for an enhanced multi-modal transport eco-system including Mobility as a Service (MaaS)	9.3	5.1	01/11/2018	18/01/2023
H2020-S2RJU-CFM-2016-01-1	PINTA	IP1 Traction TD1 and Brakes TD5 – Phase 1	28.8	12.6	01/09/2016	14/09/2020
H2020-S2RJU-CFM-2018	PINTA-2	IP1 Traction TD1 and Brakes TD5 – Phase 2	31	12.7	01/09/2018	07/03/2022
H2020-S2RJU-2020	PINTA3	IP1 Traction TD1– Phase 3 and HVAC TD8	21.9	8.6	01/12/2020	29/11/2024
H2020-S2RJU-CFM-2017	PIVOT	Performance improvement for vehicles on track	15.4	7.6	01/10/2017	17/03/2021
H2020-S2RJU-CFM-2019	PIVOT2	Performance Improvement for Vehicles on Track 2	46.4	17.9	01/10/2019	28/11/2024
H2020-S2RJU-CFM-2015-01-1	PLASA	Smart Planning and Safety for a safer and more robust European railway sector	1.1	0.3	01/09/2016	16/07/2019
H2020-S2RJU-CFM-2018	PLASA-2	Smart Planning and Virtual Certification	1.8	0.8	01/09/2018	21/03/2022
H2020-S2RJU-2020	TAURO	Technologies for Autonomous Rail Operation	3.8	2	01/12/2020	25/01/2024
H2020-S2RJU-CFM-2015-01-1	X2Rail-1	Start-up activities for Advanced Signalling and Automation Systems	44.4	18	01/09/2016	21/08/2024
H2020-S2RJU-CFM-2017	X2RAIL-2	Enhancing railway signalling systems based on train satellite positioning, on-board safe train integrity, formal methods approach and standard interfaces, enhancing Traffic Management System functions	28.9	13.4	01/09/2017	25/01/2024
H2020-S2RJU-CFM-2018	X2Rail-3	Advanced Signalling, Automation and Communication System (IP2 and IP5) – Prototyping the future by means of capacity increase, autonomy and flexible communication	33.8	17.2	01/12/2018	21/02/2023
H2020-S2RJU-CFM-2019	X2Rail-4	Advanced signalling and automation system - Completion of activities for enhanced automation systems, train integrity, traffic management evolution and smart object controllers	42.3	17.8	01/12/2019	05/12/2024
H2020-S2RJU-2020	X2Rail-5	Completion of activities for Adaptable Communication, Moving Block, Fail safe Train Localisation (including satellite), Zero on site Testing, Formal Methods and Cyber Security	34.7	14.8	01/12/2020	29/11/2024

Closed Projects related to Open call topics for S2R JU non-Members

TOPIC	ACRONYM	TITLE	PROJECT VALUE	GRANT	START DATE	CLOSURE DATE

H2020-S2RJU-OC-2019	4SECURAIL	FORMAL METHODS AND CSIRT FOR THE RAILWAY SECTOR	0.5	0.5	01/12/2019	29/06/2022
H2020-S2RJU-OC-2020	AB4Rail	Alternative Bearers for Rail	0.3	0.3	01/01/2021	13/05/2023
H2020-S2RJU-OC-2018	ASSETS4RAIL	Measuring, monitoring and data handling for railway assets; bridges, tunnels, tracks and safety systems	5.5	5.5	01/12/2018	09/03/2023
H2020-S2RJU-OC-2017	ASTRail	Satellite-based Signalling and Automation Systems on Railways along with Formal Method and Moving Block validation	1.8	1.8	01/09/2017	29/04/2020
H2020-S2RJU-OC-2018	B4CM	Blockchains as a Distributed Ledger for Attribution of RCM Data in Rail	0.4	0.4	01/12/2018	01/03/2024
H2020-S2RJU-2021	Ben[at]rail	Benefits at rail, top-down holistic approach of impact and benefits to make rail attractive for stakeholders	0.1	0.1	27/06/2023	22/07/2023
H2020-S2RJU-OC-2019	CARBODIN	Car Body Shells, Doors and Interiors	3.3	3.3	01/12/2019	08/07/2024
H2020-S2RJU-OC-2015-01-2	CYRAIL	Cybersecurity in the Railway sector	1.5	1.5	01/10/2016	28/01/2020
H2020-S2RJU-2021	DACcelerate	Accelerated DAC transformation to full digital rail freight operations in Europe	2.4	1.6	31/01/2023	02/12/2024
H2020-S2RJU-OC-2020	DAYDREAMS	Development of prescriptive AnalYtics baseD on aRtificial intElligence for iAMS	1.7	1.7	01/12/2020	10/01/2024
H2020-S2RJU-OC-2015-01-2	DESTINATE	Decision supporting tools for implementation of cost-efficient railway noise abatement measures	1	1	01/11/2016	14/08/2019
H2020-S2RJU-OC-2015-01-2	Dynafreight	Innovative technical solutions for improved train Dynamics and operation of longer Freight Trains	0.9	0.9	01/11/2016	24/01/2019
H2020-S2RJU-OC-2018	EMULRADIO4RAIL	Emulation of radio access technologies for railway communications	0.7	0.7	01/12/2018	26/11/2021
H2020-S2RJU-OC-2017	ETALON	Energy harvesting for signalling and communication systems	1.7	1.7	01/09/2017	09/12/2020
H2020-S2RJU-OC-2017	FAIR Stations	Future Secure and Accessible Rail Stations	1.2	1.2	01/09/2017	10/02/2021
H2020-S2RJU-OC-2018	FLEX-RAIL	Paradigm shifts for railway – Technology uptake strategies for a lean, integrated and flexible railway system	1	1	01/12/2018	14/12/2021
H2020-S2RJU-OC-2019	FUNDRES	Future unified DC Railway Electrification System	0.7	0.7	01/12/2019	03/10/2022
H2020-S2RJU-OC-2018	GATE4RAIL	GNSS Automated Virtualized Test Environment for Rail	1	1	01/12/2018	07/02/2022
H2020-S2RJU-OC-2020	Gearbodies	Innovative Technologies for Inspecting Carbodies and for Development of Running Gear	2.4	2.4	01/12/2020	19/08/2024

H2020-S2RJU-OC-2016-01-2	GoF4R	Governance of the Interoperability Framework for Rail and Intermodal Mobility	1.8	1.8	01/11/2016	08/11/2019
H2020-S2RJU-OC-2015-01-2	GoSAFE RAIL	GoSAFE RAIL- Global Safety Management Framework for Rail Operations	1.3	1.3	01/10/2016	24/07/2020
H2020-S2RJU-OC-2020	HYPERNEX	Hypernex: Ignition of the European Hyperloop Ecosystem	0.3	0.3	01/12/2020	24/07/2020
H2020-S2RJU-OC-2017	IN2DREAMS	Intelligent solutions 2wards the Development of Railway Energy and Asset Management Systems in Europe	2.1	2.1	01/09/2017	21/02/2023
H2020-S2RJU-OC-2020	IN2ZONE	The Next Generation of Railway Transition Zones	1.3	1.3	01/12/2020	02/12/2024
H2020-S2RJU-OC-2015-01-2	INNOWAG	Innovative monitoring and predictive maintenance solutions on lightweight Wagon	1.4	1.4	01/11/2016	03/08/2020
H2020-S2RJU-OC-2020	IP4MaaS	Shift2Rail IP4 to support the deployment of Mobility as a Service	2	2	01/12/2020	10/01/2024
H2020-S2RJU-OC-2019	LOCATE	Locomotive bOgie Condition mAinTEnance	1.5	1.5	01/11/2019	21/11/2023
H2020-S2RJU-OC-2018	M2O	Make Rail the hope for protecting nature 2 future operation	0.6	0.6	01/12/2018	16/06/2021
H2020-S2RJU-OC-2017	Mat4Rail	Designing the railway of the future: Fire resistant composite materials and smart modular design	3.5	3.5	01/10/2017	06/06/2020
H2020-S2RJU-OC-2015-01-2	MISTRAL	Communication Systems for Next-generation Railways	0.5	0.5	01/11/2016	08/08/2019
H2020-S2RJU-OC-2017	MOMIT	Multi-scale Observation and Monitoring of railway Infrastructure Threats	0.6	0.6	01/09/2017	27/10/2020
H2020-S2RJU-OC-2018	MOVINGRAIL	Moving block and Virtual coupling New Generations of Rail signalling	1.2	1.2	01/12/2018	28/06/2021
H2020-S2RJU-OC-2018	MVDC-ERS	Flexible medium voltage DC electric railway systems	0.1	0.1	01/12/2018	12/03/2023
H2020-S2RJU-OC-2017	My-TRAC	My-TRAC	3.5	3.5	01/09/2017	03/11/2021
H2020-S2RJU-OC-2015-01-2	NEAR2050	NEAR2050 - future challenges for the rail sector	0.4	0.4	01/10/2016	18/10/2019
H2020-S2RJU-OC-2019	NEXTGEAR	Next generation methods, concepts and solutions for the design of robust and sustainable running Gear	2.6	2.6	01/12/2019	21/02/2023
H2020-S2RJU-OC-2015-01-2	OPEUS	Modelling and strategies for the assessment and Optimisation of Energy Usage aspects of rail innovation	0.7	0.7	01/11/2016	08/09/2020
H2020-S2RJU-OC-2019	OPTIMA	cOmmunication Platform for Trafflc ManAgement demonstrator	1.9	1.9	01/12/2019	04/01/2024

H2020-S2RJU-OC-2017	OPTIYARD	Optimised Real-time Yard and Network Management	1.4	1.4	01/10/2017	09/12/2020
H2020-S2RJU-OC-2020	PERFORMINGRAIL	PERformance-based Formal modelling and Optimal tRaffic Management for movING-block RAILway signalling	1.3	1.3	01/12/2020	19/01/2024
H2020-S2RJU-OC-2019	RAILS	Roadmaps for A.I. integration in the rail sector	0.1	0.1	01/12/2019	01/03/2024
H2020-S2RJU-OC-2020	RECET4Rail	Reliable Energy and Cost Efficient Traction system for Railway	2.3	2.3	01/12/2020	22/11/2024
H2020-S2RJU-OC-2019	RIDE2RAIL	Travel Companion enhancements and RIDE-sharing services syncronised to RAIL and Public Transport	3	3	01/12/2019	10/01/2024
H2020-S2RJU-OC-2017	RUN2Rail	Innovative Running gear solutions for new dependable, sustainable, intelligent and comfortable rail vehicles	2.5	2.5	01/09/2017	03/08/2020
H2020-S2RJU-OC-2016-01-2	SAFE4RAIL	Safe architecture for Robust distributed Application Integration in rolling stock	6.7	6.7	01/10/2016	15/07/2020
H2020-S2RJU-OC-2018	SAFE4RAIL-2	Smart Planning and Virtual Certification	4	4	01/10/2018	04/04/2022
H2020-S2RJU-OC-2020	Safe4Rail-3	Advanced safety architecture and components for next generation TCMS in Railways	4.6	4.6	01/12/2020	22/11/2024
H2020-S2RJU-OC-2016-01-2	S-CODE	Switch and Crossing Optimal Design and Evaluation	4.4	4.4	01/11/2016	28/11/2021
H2020-S2RJU-OC-2018	SHIFT2MAAS	Shift2Rail IP4 enabling Mobility as a Service and seamless passenger experience	1.4	1.4	01/12/2018	16/01/2022
H2020-S2RJU-OC-2020	SILVARSTAR	SoIL Vibration and AuRalisation Software Tools for Application in Railways	1	1	01/11/2020	07/11/2023
H2020-S2RJU-OC-2015-01-2	SMART	Smart Automation of Rail Transport	1	1	01/10/2016	02/02/2021
H2020-S2RJU-OC-2019	SMART2	Advanced integrated obstacle and track intrusion detection system for smart automation of rail transport	1.5	1.5	01/12/2019	17/08/2023
H2020-S2RJU-OC-2017	SMaRTE	Smart Maintenance and the Rail Traveller Experience	0.7	0.7	01/09/2016	02/07/2020
H2020-S2RJU-OC-2018	SPRINT	Semantics for Performant and scalable Interoperability of multimodal Transport – SPRINT	2	2	01/12/2018	21/10/2021
H2020-S2RJU-OC-2016-01-2	ST4RT	Semantic Transformations for Rail Transportation	1	1	01/11/2016	21/06/2019
H2020-S2RJU-OC-2020	STREAM	Smart Tools for Railway work safety and performance improvement	1.1	1.1	01/12/2020	01/03/2024
H2020-S2RJU-OC-2018	TER4RAIL	Transversal Exploratory Research Activities for Railway	0.5	0.5	01/12/2018	28/05/2021

H2020-S2RJU-OC-2019	Transit	Train pass-by noise source characterization and separation tools for cost-effective vehicle certification	1.3	1.3	01/12/2019	16/02/2024
H2020-S2RJU-OC-2019	Translate4Rail	Translation for breaking language barriers in the railway field	0.2	0.2	01/12/2019	09/08/2022
H2020-S2RJU-OC-2015-01-2	VITE	Virtualisation of the testing environment	0.9	0.9	01/11/2016	22/06/2020

For the EU-RAIL Programme, by the end of 2024, the JU had signed a total of 23 EU-Rail grant agreements. The signed EU-Rail grants agreements correspond to R&I activities in the Programme that reached EUR 653.7 million (278.2M in Funding, 155.5M in IKOP contributions, 170.4M in IKAA contributions, 41.9M from Associated Members Contributions and 7.8M in Non-Member Contributions).

Acronym	Project Title	Call Reference	Period	Project Value (signed GA)
FP1 - MOTIONAL	Flagship Project 1 - Mobility management multimodal environment and digital enablers	HORIZON-ER-JU-2022-01	01/12/2022 to 30/09/2026	92.578.437,17
FP2 - R2DATO	Flagship Project 2 - Rail to Digital automated up to autonomous train operation	HORIZON-ER-JU-2022-01	01/12/2022 to 31/05/2026	160.775.910,38
FP3 - IAM4RAIL	Flagship Project 3 - Holistic and Integrated Asset Management for Europe‘s RAIL System	HORIZON-ER-JU-2022-01	01/12/2022 to 30/11/2026	108.748.800,11
FP4 - Rail4EARTH	Flagship Project 4 - Sustainable and green rail systems	HORIZON-ER-JU-2022-01	01/12/2022 to 30/11/2026	95.117.482,11
FP5 – TRANS4M-R	Flagship Project 5 - Transforming Europe‘s Rail Freight	HORIZON-ER-JU-2022-01	01/07/2022 to 31/12/2026	102.874.032,83
FP6 - FutuRe	Flagship Project 6 - Delivering innovative rail services to revitalise capillary lines and regional rail services	HORIZON-ER-JU-2022-01	01/12/2022 to 30/11/2026	32.905.210,30
RAIL4CITIES	Railway stations for green and socially inclusive cities	HORIZON-ER-JU-2022-02	01/07/2023 to 30/06/2025	858.601,07
InBridge4EU	Enhanced INterfaces and train categories FOR dynamic compatibility assessment of EUropean railway BRIDGEs	HORIZON-ER-JU-2022-02	01/09/2023 to 31/08/2026	999.921,24

ESEP4Freight	European Shift Enabler Portal for Freight	HORIZON-ER-JU-2022-02	01/09/2023 to 31/08/2026	1.299.750,00
Academics4Rail	Building a community of railway scientific researchers and academia for ERJU and enabling a network of PhDs (academia teaming with industry)	HORIZON-ER-JU-2022-02	01/09/2023 to 28/02/2027	1.858.357,43
MaDe4Rail	Maglev-Derived Systems for Rail	HORIZON-ER-JU-2022-02	01/07/2023 to 30/09/2024	2.561.063,03
Pods4Rail	Concept Development of a System for Pods and Pod-Carriers to be used as Moving Infrastructures mainly for Rail, but as well for Road and Ropeways	HORIZON-ER-JU-2022-02	01/09/2023 to 28/02/2026	4.578.712,55
DACcord	DAC migration roadmap towards deployment and related activities	HORIZON-ER-JU-2022-02	01/09/2023 to 31/03/2026	1.499.829,16
LEADER 2030	Learnings for European Autonomy to Deliver Europe's Rail in 2030	HORIZON-ER-JU-2022-02	01/07/2023 to 31/12/2025	700.032,12
DACFIT	DAC: Freight's intelligent transformation	HORIZON-JU-ER-2023-01	15/10/2024 to 14/10/2026	1.897.326,00
NEXUS	Next-gen technologies for enhanced metro operations	HORIZON-JU-ER-2023-01	01/10/2024 to 30/09/2026	3.607.995,63
PhDs EU-Rail	Extending the Rail Network of PhDs in Europe's Rail Joint Undertaking	HORIZON-JU-ER-2023-01	01/10/2024 to 30/09/2027	1.999.875,00
SYMBIOSIS	SYstemic Mobilisation for Joint Biodiversity and Infrastructure	HORIZON-JU-ER-2023-01	01/09/2024 to 31/08/2027	3.034.102,38
Travel Wise	TRansformation of AViation and rAirway soLutions toWards Integration and SynergiEs	HORIZON-JU-ER-2023-01	01/10/2024 to 30/09/2027	6.769.891,75
XCROSS	The next generation of railway crossing asset management technology	HORIZON-JU-ER-2023-01	01/10/2024 to 31/03/2027	2.734.729,64
Hyper4Rail	A Giant Leap for Loop: Towards a harmonized	HORIZON-ER-JU-2024-01	01/12/2024 to 30/11/2026	2.568.440,95

	implementable Hyperloop concept with Hyper4Rail			
QuieterRail	A step change in prediction, mapping, acceptance testing and cost-effective mitigation for railway noise and vibration	HORIZON-JU-ER-2023-01	01/10/2024 to 30/09/2027	4.539.673,20
FP2-MORANE-2	MObile radio for RAilway Networks in Europe 2	HORIZON-ER-JU-2024-01	01/12/2024 to 30/09/2027	19.087.735,25

1.6. Openness, cooperation, synergies and cross-cutting themes and activities

In terms of national funded R&I activities in the Railway sector, the JU invited the relevant Member States to present their programmes and projects in the context of the meetings of the State Representative Group (SRG). This has allowed discussion on ways to interconnect the different activities and ensure that resources are leveraged to achieve the best results. In 2024 EU-Rail implemented the first collaboration following the output from the SRG. This is an ongoing process, which becomes increasingly relevant in view of standardisation processes and market uptake.

During 2024, the JU reinforced its engagement with the presidencies of the Council of the European Union, with a particular focus on the Belgian Presidency. In collaboration with the Belgian Transport Ministry, the European Commission, and EU-Rail, the JU co-hosted a high-level event during the Connecting Europe Days. A dedicated session on rail freight, co-programmed by the three entities, featured the participation of the Belgian Deputy Prime Minister and Minister for Mobility. The event also welcomed the German and Latvian Ministers of Transport, further strengthening ties with Member States.

EU-RAIL has created synergies with other JUs, partnerships, and Executive Agencies:

- **SNS JU:** Launch of the FP2-MORANE-2 project in December 2024, jointly funded by EU-RAIL and SNS JU. EU-wide testing and validation campaign of the FRMCS V2 specifications, the next EU rail communication system.
- **SESAR 3 JU:** Launch of the FP1-Travel Wise project in October 2024, jointly funded by EU-RAIL and SESAR 3 JU. The project will use digital solutions and lessons from the air sector to enhance coordination and create an integrated European transport network.
- **Clean Hydrogen JU:** EU-RAIL is now member of Clean Hydrogen JU stakeholders group since 2024, providing input/feedback regarding needed developments and potential synergies between the Clean Hydrogen Joint Undertaking and the rail sector.
- **EUSPA/ESA**: Continuation in 2024 of the collaboration with the EU Agency for the Space Programme (EUSPA) and with the European Space Agency (ESA) of the project on EGNOS for rail, under the strategic leadership of the Commission and in full coordination with ERA, for delivering through R&I the technical and operational elements to reach competitive and resilient satellite-based rail services. Work on rail requirements has progressed well during the year. Preparation for demonstration activities will continue in 2025.

Coherence and synergies in relation to major national (sectoral) policies, programmes and activities: It is estimated that around 15% of the EU stimulus package called Recovery and Resilience Facility -RRF- will be invested in different areas of rail national systems. There is a need to ensure maximum levels of complementarity and impact, including focusing on future-proof investments. This will require to leverage local, regional and national investments to complement the research and innovation activities performed at EU-Rail level and vice versa. In this respect, the States Representatives Group has delivered in 2024 countries report describing the national or regional policies in the scope of the Europe's Rail joint

undertaking and identified specific national projects where cooperation could be sought with the actions funded by EU-Rail.

EU-Rail also continued the cooperation with a number of key international partners, such as FRA, APTA, FTA in the US and CUTRIC (CA).

The JU continued also its participation to the Digital PRIME working group, promoted by the European Commission together with rail infrastructure managers around traffic planning/management improvements mainly.

In terms of synergies with other Union Programmes, the JU works closely with the other Joint Undertakings sharing the same building, infrastructure, etc. maximising the opportunity for collaboration in terms of administrative and operational activities.

Beyond the operational activities, 2024 was the third year of implementation of Article 13 SBA, where EU-Rail took over the responsibility for the coordination of the Back Office Arrangement (BOA) Accounting Services. Other 3 BOAs were established led by other JUs where EU-Rail took also a supporting role, please refer to the section 2.7.2 “Efficiency gains and synergies”, of the present document.

1.7. Progress against Key Impact Pathways and JU’s Key Performance Indicators

1.7.1. Progress against H2020 legacy Key Performance Indicators

The H2020 Key performance Indicator results for the year 2024 are presented in Annex E. The JU has taken into its scoreboard all Horizon 2020 indicators, which have been established for the entire Research family by the Commission, to the extent they can be applied to the JU in view of providing meaningful results.

Comments to some indicators are provided in the tables in Annex E or in the related section of this CAAR, to which the indicators refer.

Within the context of the CCA activities, during 2043 the JU continued the work to maintain the ‘S2R 2030 Impact Forecast Model’ ensuring the next Release, resulting from the update of the data input from the different projects and TDs. The latest figures (Release 5) are provided in Annex E Table IV of the present CAAR.

1.7.2. Progress against General Horizon Europe Key Impact Pathways Indicators (KIPs)

The HE Key Performance Indicator results for the year 2024 are presented in Annex F.

1.7.3. Progress against HE Common JUs Key Performance Indicators

The HE Key Performance Indicator results for the year 2024 are presented in Annex F.

1.7.4. Progress against JU-specific Key Performance Indicators

The EU-Rail specific Key Performance Indicator results for the year 2024 are presented in Annex F.

1.8. Dissemination and information about project results

In 2024, Europe’s Rail continued its commitment to disseminate the results of its funded projects. Ensuring visibility and impact remained a key priority, with dissemination efforts focused on maximising outreach through multiple channels, including events, social media, newsletters, and the corporate website. The objective was to enhance awareness among stakeholders and facilitate knowledge transfer across the rail sector.

Projects were actively encouraged to promote their results through Europe’s Rail’s communication platforms. Regular interactions between the Joint Undertaking and project consortia ensured a coordinated approach to dissemination. Europe's Rail also provided visibility by featuring project updates in corporate communications and supporting their presence at key industry events.

A new initiative was introduced in 2024 to streamline the collection of project updates. A dedicated tool, through EU Survey, was implemented, allowing projects to submit their latest news at least once a month. This structured approach ensured that Europe's Rail could efficiently gather information and share it through its corporate channels, including the newsletter, social media, and website. To facilitate participation, calendar reminders were sent to all projects, and detailed guidelines were developed to assist them in completing the survey effectively. All projects were consulted and were able to provide their preference as to the tool used through a dedicated anonymous poll which resulted in the majority opting for EU Survey.

A key milestone in 2024 was the launch of the new Europe's Rail Catalogue of Solutions, an interactive platform designed to showcase cutting-edge research and innovation results. This catalogue highlights tangible solutions developed to meet the evolving needs of final users, operators, infrastructure managers, and suppliers across the rail sector. With its user-friendly format, stakeholders are able to explore various topics, access detailed information, read in-depth articles, and download factsheets summarising key insights. Initially featuring results from the Shift2Rail programme, the catalogue will continue to be updated as new results emerge from the Europe's Rail programme. This publication plays a crucial role in the dissemination of project outcomes, ensuring that innovations reach relevant audiences and showcase the impact of our programmes.

As in previous years, to strengthen communication between Europe's Rail's Programme Office and the projects, joint meetings were regularly held with Project Coordinators, Flagship Project Managers, and Communication Work Package Leaders. These meetings facilitated discussions on progress made in communication and dissemination strategies, best practices, and alignment of targets and milestones. They also fostered synergies between the corporate communication team and the projects, as well as among the projects themselves. Projects received guidance on best practices for planning events, engaging with the media, and producing scientific publications.

Additionally, a series of feature articles highlighting the main objectives and expected outcomes of projects, continuing from last year, was published on the Europe's Rail website and disseminated through the monthly newsletter.

In 2024, Europe's Rail continued to leverage shared dissemination efforts among its projects, coordinated by the Joint Undertaking's Communication Team. The Project Results webpage, originally launched in collaboration with the Programme Unit, remained a priority for ensuring consistent communication of achieved progress. As the final results from Shift2Rail projects were published, Europe's Rail shifted its focus to promoting Europe's Rail project outcomes separately in the news section. This approach allowed for a clearer distinction between legacy and ongoing research, while also maximizing visibility. The structured presentation of deliverables, with concise descriptions highlighting their contribution to advancing rail transport, ensured effective outreach. Additionally, these updates were repurposed for broader dissemination across Europe's Rail's corporate social media channels and newsletters, creating a multiplier effect for visibility and engagement.

In November 2024, the Europe's Rail General Assembly provided a vital platform to reflect on the past year's achievements and outline strategic objectives for the future. Held over two days, the event gathered key stakeholders to discuss the progress of ongoing research and innovation efforts. The first day focused on strategic discussions, with reports from advisory bodies analysing how research and innovation can drive a more competitive and sustainable rail sector in alignment with the priorities of the new European Commission. The second day, designed as an open online session, broadened participation by allowing a wider audience to engage with updates from the System Pillar, Innovation Pillar, and Deployment Group. Additionally, the communications team presented various ways for stakeholders to stay actively involved in Europe's Rail's initiatives, reinforcing the Joint Undertaking's commitment to transparency and knowledge-sharing.

Europe's Rail also maintained a strong presence at major industry events and conferences, where project results were showcased through dedicated sessions, exhibition stands, and panel discussions. Participation in these events provided opportunities to engage with stakeholders, share progress, and demonstrate the impact of research and innovation efforts.

As a flagship event, InnoTrans 2024 (Berlin, 24-27 September 2024) served as a key platform for disseminating Europe's Rail project results to a global audience. For the first time, Europe's Rail had a joint stand together with the European Commission and the European Union Agency for Railways, reinforcing collaboration across institutions. All Flagship Projects were present with demonstrations, providing an interactive experience for attendees. A highlight of the event was the Connected Tram Live Demo from

Oslo, part of the Europe's Rail FP2 R2DATO project, which showcased the latest developments in tram connectivity and technology. This live remote tram operations demonstration, held in the presence of high-level participants, exemplified Europe's Rail's commitment to innovative rail solutions.

The Connecting Europe Days 2024 (Brussels, 2-5 April 2024) was another significant event for promoting project outcomes. On the opening day, the European DAC Delivery Programme, enabled by Europe's Rail, organised 'The Future of Rail Freight – see how it works in the 21st century!' side event at Train World under the Belgian Presidency of the Council of the European Union. The event featured high-level European transport stakeholders, including Belgian Vice Prime Minister and Minister of Transport, Mr. Georges Gilkinet. Participants had the opportunity to witness a live Digital Automatic Coupling (DAC) demonstration, illustrating the potential of rail automation to revolutionise freight transport.

The Transport Research Arena (TRA) 2024 (Dublin, 15-18 April 2024) provided an essential platform for presenting cutting-edge research and technological advancements in rail transport. For the first time, Europe's Rail had a joint stand with three other Joint Undertakings—SESAR, Clean Aviation, and Clean Hydrogen—demonstrating a united approach to innovation in European transport. Throughout the event, several Europe's Rail projects took part in presentations to showcase their results, including dedicated poster sessions that allowed researchers to present their findings in a dynamic and engaging format.

2. SUPPORT TO OPERATIONS

2.1. Communication activities

The JU continued to promote the activities of the Programme during 2024. The JU communication activities in 2024 were focused on the continued promotion of the S2R Programme and bringing as much visibility as possible to the results of its R&I activities, while also raising awareness of the Europe's Rail Programme, its mission and vision, its Calls for Proposals and the System and Innovation Pillars, as well as the newly established Deployment Group. In 2024, the conclusion of the Shift2Rail projects was a significant milestone, marked by the launch of a dedicated social media communication campaign. Additionally, a digital Solutions Catalogue was created to showcase key outputs and success stories from the programme. This catalogue will continue to be enriched with results from the EU-Rail programme.

The majority of the communication activities in 2024 revolved around organisation and participation to events, as well as streamlining dissemination activities and promoting the outputs of the EU-Rail Flagship and Exploratory Research projects.EU Rail also puts a particular emphasis on maintaining an active network of stakeholders who engage regularly in joint activities with the JU.

Alongside the key events organised and attended by the JU in 2024 (see Annex C), the JU reinforced its engagement with the presidencies of the Council of the European Union, with a particular focus on the Belgian Presidency. In collaboration with the Belgian Transport Ministry, the European Commission, and EU-Rail, the JU co-hosted a high-level event during the Connecting Europe Days. A dedicated session on rail freight, co-programmed by the three entities, featured the participation of the Belgian Deputy Prime Minister and Minister for Mobility. The event also welcomed the German and Latvian Ministers of Transport, further strengthening ties with Member States.

Relations with the European Parliament are regular and the JU's expertise is searched to contribute to a number of working activities from the TRAN Committee in particular. The relations were further strengthened via the European Startup Prize for Mobility, an EU startup acceleration programme supported by EU-Rail.

Another key event was the EU-Rail participation to Transport Research Arena (TRA) 2024.For the first time, EU-Rail shared a stand with Clean Hydrogen JU, Clean Aviation JU, and SESAR 3 JU, emphasising synergies in transport research and innovation. The event provided valuable insights into mobility trends, industry achievements, and best practices in policy and deployment. EU-Rail's team and projects actively contributed through technical, strategic, and Young Scientists award as part of the TRA Visions Competition. A highlight was welcoming students from Transport Infrastructure Ireland's Schools Outreach Programme to the Transport for Europe stand, offering them insights into EU institutions' roles in transport.

The JU participated to nearly 58 different events across Europe and beyond, strongly showcasing the Partnership's importance within the rail and transport communities globally. A key example from 2024 is the participation to the new edition of InnoTrans. EU-Rail for the first time in collaboration with the European Commission and the European Union Agency for Railways, participated to the world's largest trade fair for transport technology, held in Berlin. The joint "Europe for Rail" stand served as a central hub for showcasing over 20 rail innovations from the EU-Rail Research and Innovation programme. The event's agenda aimed at fostering collaboration and innovation. A VIP event at the EU stand featured CEOs, Members of the European Parliament, and government representatives, highlighting cutting-edge rail technologies.

Throughout the fair, the JU organised its first edition of innovation tours of EU-Rail founding members' stands provided attendees with insights into the latest technological advancements. Discussions on topics such as Digital Automatic Coupling (DAC), the future of the European Rail Traffic Management System (ERTMS), and the role of rail in Europe's defence underscored the sector's dedication to addressing current and future challenges.

To support EU Rail's message on its presence at InnoTrans, a dedicated high-speed train was organised to transport key high-level rail stakeholders from Brussels to Berlin, on Monday 23rd September. The train carried over 300 passengers who attended conferences and workshops during the journey, addressing cross borders travelling and a symbol of the commitment of the rail community to a sustainable means of transport. The event featured high-level European transport stakeholders, including Belgian Vice Prime Minister and Minister of Transport, Mr. Georges Gilkinet and Tilly Metz, Member of the European Parliament.

The event was organised by EU Rail jointly with a task force of 30 contributing members and associations, including DG MOVE, highlighting the important of collaboration within the rail sector as well as with institutions stakeholders (with the presence of representatives from the MS, EP, EC, ERA, EUSPA).

EU Rail attended the EUAN event organised for agencies and JUs at the European Parliament on 30th September to 3rd October, with a dedicated exhibition and demo section showcasing examples of new solutions developed in our Programme. This gave EU-Rail the opportunity to liaise with MEPs and to start discussions on the future joint JU event to be organised in the spring 2025 at the European Parliament.

EU-Rail also organised important initiatives such as in collaboration with DG MOVE, ERA, ALE, CER, EIM, and UNIFE, the 'Women in Rail' award to recognise outstanding contributions in the sector. The initiative featured three distinct prizes, awarded following a rigorous jury evaluation. A total of 70 applications were submitted, with 60 meeting the eligibility criteria. The winners were honoured during a formal ceremony at InnoTrans in Berlin.

The third General Assembly[31] of EU-Rail was organised on 21-22 November 2024, supporting the operational activities of the JU and gathering all participants to the research and innovation activities of EU-Rail in accordance with Article 93(5) of the Single Basic Act. The primary objective of the assembly was to stimulate reflection on the overall direction of the activities of EU-Rail, while conducting an open and transparent discussion on the progress of the Master Plan implementation. The event was promoted on social media, in the newsletter and on the corporate website and attracted a large number of participants.

On December 10, EU-Rail organised a dedicated workshop on the future of the Programme with the members of its governing board and observers, supported by a consultant fostering a creative environment in the art-of-hosting participatory leadership.

EU-Rail placed a strong focus on communicating the Call for Associated Members to attract a diverse pool of applicants. To maximise outreach, a dedicated Information Day was organised, complemented by targeted paid social media campaigns to boost visibility.

Promotion of the 2024 Calls for Proposals was as usually a focus of the yearly communication activities. In 2024 one Call for Proposals was launched and widely promoted through website, newsletter, social media channels and through events and this promotional content was successfully re-shared by EU-Rail Founding Members, the European Commission and partners as well as reported in the press (see Annex C). Additionally, the Info Day was further promoted by the Horizon Europe National Contact Points Network, including organisation of regional Info Days. To ensure high participation rate to the Call, a paid LinkedIn

[31] https://rail-research.europa.eu/about-europes-rail/europes-rail-structure-of-governance/general-assembly/

campaign was launched. A particularity of this Call was the joint topic on 'Digital and Automated testing and operational validation of the next EU rail communication system with the SNS Joint Undertaking. To further leverage on the synergies offered by the collaboration, a joint communication campaign was launched, including a social media campaign and visual materials In 2024, EU-Rail continued to utilise a long-term matchmaking platform encouraging interested applicants to find like-minded experts, exchange ideas and schedule meetings. The platform was open until Call closure.

In 2024, the JU Communications organised two meetings with the Communication Officers of Founding Members companies, as well as other key partners, to align the key priorities and communication expectations, as well as agree on best practices on information exchange. The meetings were used as an opportunity to involve Founding Members in events organised by the JU, especially InnoTrans 2024. These meetings have deemed successful as Founding Members consistently communicate about EU-Rail both internally and externally. Additionally, Founding Members were strongly present in EU-Rail InnoTrans activities, especially via the 1st edition of the innovation tours. As described in section 1.9., in 2024 the JU Communications organised two meetings with the Flagship Projects, as well as the exploratory research projects, to align on the Communication and Dissemination Strategies and inform the projects on potential synergies and collaboration with the Corporate Communications of the JU, especially in terms of event participation. An individual meeting was held with the synergy project with S3JU.

Furthermore, press relations in 2024 were also strengthened, increasing media presence not just in specialised rail press (particularly in the Railway Gazette, International Railway Journal, Global Railway Review, Rail Target, and Railway Pro – all press articles are listed in Annex C), but also in more mainstream press outlets, such as Euronews, CNN EURACTIV and the Brussels Times. In 2024, the JU signed a partnership with EURACTIV. The JU also had a collaboration agreement with Rail Live organisers.

In terms of website, in 2024, the JU undertook a complete revamp of its corporate website in a two-phase process. First, a thorough review of user experience (UX) behaviour was conducted, followed by the technical implementation of the findings. Key enhancements included a redesigned navigation system based on user feedback, a new landing page, updated templates, an upgraded visual identity, improved plug-ins for events and news, and the launch of a fully digital Solutions Catalogue highlighting key success stories from both the Shift2Rail and Europe's Rail programmes.

EU-Rail continued placing increased efforts on its social media channels, which resulted in a major follower growth on LinkedIn. At the end of 2024, EU-Rail's LinkedIn account had more than 14,000 followers. The overall impressions reached on Europe's Rail LinkedIn channel were over 1.2 million in 2024, compared to 1 million in 2023, showcasing that there is strong interest to follow content produced by the JU. Moreover, the JU also kept increasing its presence on its YouTube channel. Efforts have been made to publish videos showing our innovations as well as recordings of our online events to ensure that even those who were unable to join can access the content. Just like in previous years, in 2024, JU also had at the heart of its strategy the promotion of the JU project results through its social media channels. Thanks to the collection tool developed by the JU, projects are able to directly propose content for organic or re-shared posts. The projects are encouraged to send content directly to the Communication Team to ensure it is promoted across the social media channels in a timely manner. In 2024 the Communication Team utilised Microsoft 365 Teams environment for collaborating with projects, as well as EU Survey for collecting content input for organic posts and articles.

During 2024, the JU published two different publications: Annual Activity Report 2023 – Executive View and Catalogue of Solutions. The publications incorporated the EU-Rail visual identity and were promoted during various events in presence, most prominently, InnoTrans, Rail Live, Joint Agencies Event at the European Parliament.

A close collaboration with the European Union Agency for Railways (ERA) in different areas, and with the European Railway Research Advisory Council (ERRAC), as well as with the different International and European organisations and associations was maintained. A continuous and constructive exchange took place with other Union bodies and agencies.

In 2024, journalists have also been targeted by the JU on social media which has proved effective as well. The fact that the Programme continues to become better known and the interest in its results progressively increases is reflected in a broader media coverage of EU-Rail compared to previous years.

Communication statistics can also be found in Annex C.

Data protection

In cooperation with the ICT Officer, the Chief Legal Officer, who also acts as the JU's Data Protection Officer, and two contractors managing the rail-research.europa.eu and projects.shift2rail.org domains, EU-Rail Communication team continued to work on making the website compliant with the data protection regulation based on the instructions provided by the European Data Protection Supervisor. It was ensured that the website platform and applications are compliant with the GDPR and EUDPR Regulations. In particular, our contractor ensured that full website maintenance procedures are carried out on a daily basis.

In 2024, EU-Rail implemented a comprehensive approach to website security and compliance with the EU General Data Protection Regulation (EUDPR). Regular server and website maintenance were conducted, including monthly updates to Ubuntu packages, PHP, Apache, and MySQL, ensuring security vulnerabilities were promptly addressed. Non-OS-related packages were also updated regularly, alongside routine checks on daily backups and retention policies to safeguard data integrity.

A key focus was on mitigating security risks, with specific fixes implemented for vulnerabilities such as an HTML injection issue in admin-ajax.php and iframe sandbox problems identified in a security report. Additionally, issues arising from plugin updates, including EventOn and EventOn - Ful Cal, were promptly resolved to maintain website functionality and security. A dynamic listing of calls was also integrated into the Tender Archive to enhance transparency.

EU-Rail prioritised compliance with EUDPR by updating its Matomo analytics code to improve data tracking in alignment with privacy regulations. The Complianz plugin was frequently updated to ensure GDPR compliance, managing user consent and cookie policies effectively. The removal of the amr shortcode any widget plugin, which posed a security risk and was no longer maintained.

To enhance cybersecurity resilience, the website's firewall (BBQ Firewall) and security monitoring plugins (Simple History and Query Monitor) were consistently updated. WordPress core and plugins, including those handling authentication (LoginWP), forms (Contact Form 7 and ReCaptcha v2), and user access (Members), received regular updates to prevent unauthorised access and potential data breaches.

As a result of this work, JU's website is considered compliant with the data protection regulation that also helped the domain to substantially improve its position in the EU Privacy Score Tool.

2.2. Legal and financial framework

In accordance with Council Regulation (EU) 2021/2085 (the "SBA"), EU-Rail is the legal and universal successor of the S2R JU, which it replaced and succeeded as from 30 November 2021.

To ensure the business continuity of the operations, in the first Governing Board meeting of EU-Rail a list was approved containing Decisions[32] adopted still under the S2R JU which continue to apply for EU-Rail in accordance with Article 174(12) of the SBA. This list includes Decisions concerning aspects related to governance, human resources, finance, audit and internal controls and compliance, and in particular the Financial Rules of the JU. The Executive Director also approved the list of ED Decisions adopted under the S2R JU that will continue to apply to EU-Rail.

Thus, as indicated in our web site[33], any references to S2R JU in the internal legal framework shall be construed as references to EU-Rail (e.g.: the JU Financial Rules adopted by S2R JU).

In 2024, the EU-Rail legal framework refers predominantly to:

- Treaty on the Functioning of the European Union (TFEU), and in particular Article 187 and the first subparagraph of Article 188 thereof.
- 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 ("the

[32] EU-Rail GB Decision n° 02/2021. The list is available at: https://rail-research.europa.eu/about-europes-rail/europes-rail-structure-of-governance/europes-rail-governing-board/

[33] https://rail-research.europa.eu/about-europes-rail/europes-rail-reference-documents/europes-rail-key-documents/

Single Basic Act")[34] as amended by Council Regulation (EU) 2023/1782 of 25 July 2023 as regards the Chips Joint Undertaking[35] . This Regulation sets up nine joint undertakings – including EU-Rail - within the meaning of Article 187 TFEU for the implementation of institutionalised European partnerships referred to in Article 10(1), point (c), of the Horizon Europe Regulation. It determines their objectives and tasks, membership, organisation and other operating rules.

- The Financial Regulation (EU, Euratom) 2018/1046[36] replaced by Regulation (EU, Euratom) 2024/2509[37] of the European Parliament and of the Council of 23 September 2024 on the financial rules applicable to the general budget of the Union (recast), which entered into force on 30 September 2024, subject to any specific provisions of the Financial Rules of EU-Rail and the Single Basic Act,
- The Financial Rules of EU-Rail[38], adopted by the Governing Board Decision N° 11/2019 of 20 December 2019[39] and entering into force on 1 January 2020.
- The EU-Rail Governing Board (GB) Decisions adopted since its establishment, which frame the functioning of EU-Rail, within the boundaries of the Single Basic Act and the EU-Rail Financial Rules, in particular the Europe's Rail Work Programme 2024 and its amendments[40] approved by the GB (draft budget, Staff Establishment Plan, Scientific Priorities, calls, tenders, etc.). As indicated in the EU-Rail GB Rules of Procedure, once adopted, the GB decisions are published on the EU-Rail website[41].

In addition:

- Regulation (EU) 2021/695 of the European Parliament and of the Council of 28 April 2021 establishing Horizon Europe – the Framework Programme for Research and Innovation, laying down its rules for participation and dissemination, and repealing Regulations (EU) No 1290/2013 and (EU) No 1291/2013[42]. This regulation) establishes the policy and legal framework for European partnerships with private or public sector partners. European partnerships are a key element of the policy approach of Horizon Europe – the Framework Programme for Research and Innovation ('Horizon Europe').
- The Staff Regulations of officials and the conditions of employment of other servants of the European Union are applicable to the staff of the JU.

Additional reference documents can be found on the JU's dedicated webpage:

https://rail-research.europa.eu/about-europes-rail/europes-rail-reference-documents/

2.3. Budgetary and financial management

	Voted Budget 2024	Budget 2024 as finally adopted

34 OJ L 427, 30.11.2021, p. 17–119.

35 OJ L 229, 18.9.2023, p. 55–62. Consolidated text available in https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02021R2085-20230921&qid=1710346003599

36 Regulation (EU, Euratom) 2018/1046 of the European Parliament and of the Council of 18 July 2018 on the financial rules applicable to the general budget of the Union, amending Regulations (EU) No 1296/2013, (EU) No 1301/2013, (EU) No 1303/2013, (EU) No 1304/2013, (EU) No 1309/2013, (EU) No 1316/2013, (EU) No 223/2014, (EU) No 283/2014, and Decision No 541/2014/EU and repealing Regulation (EU, Euratom) No 966/2012. OJ L 193, 30.7.2018, p.1.

37 OJ L 2024/2509, 26.9.2024.

38 By Delegated Regulation (EU) 2019/887, the Commission adopted the model financial regulation for public-private partnership bodies to ensure sound financial management of Union funds and to enable public-private partnership bodies like S2R JU to adopt their own financial rules. The model financial regulation should be consistent with the provisions of Regulation (EU, Euratom) 2018/1046. The S2R JU shall adopt its financial rules in accordance with this model financial regulation.

39 https://rail-research.europa.eu/wp-content/uploads/2020/01/S2R-JU-Financial-Rules.pdf

40 https://rail-research.europa.eu/about-europes-rail/europes-rail-reference-documents/europes-rail-annual-work-plan-and-budget/

41 https://rail-research.europa.eu/about-europes-rail/europes-rail-structure-of-governance/europes-rail-governing-board/

42 OJ L 170, 12.5.2021, p. 1–68. Current consolidated version: 01/03/2024

STATEMENT OF REVENUE				
Heading	*Commitment appropriations (in EUR)*	*Payment appropriations (in EUR)*	*Commitment appropriations (in EUR)*	*Payment appropriations (in EUR)*
EU contribution excl. EFTA	***104.994.557***	***71.471.785***	***104.994.557***	***71.433.829***
of which Administrative (Title 1 and 2)	*2.395.762*	*2.395.762*	*2.395.762*	*2.395.762*
of which frontloaded commitments (Title 1 and 2)	*-*	*522.228*	*-*	*484.272*
of which Operational (Title 3)	*102.598.795*[43]	*68.553.795*	*102.598.795*	*68.553.795*
Third countries contribution including EFTA	***3.681.407***	***2.524.408,14***	***3.681.407***	***2.527.281***
of which Administrative (Title 1 and 2)	*84.810*	*97.604*	*84.810*	*100.477*
of which Operational (Title 3)	*3.596.597*	*2.426.804*	*3.596.597*	*2.426.804*
Financial Members other than the Union contribution	***3.015.594***	***3.015.594***	***3.015.594***	***3.015.594***
of which Administrative (Title 1 and 2)	*3.015.594*	*3.015.694*	*3.015.594*	*3.015.594*
of which Operational (Title 3)	*-*	*-*		
Interest generated	*-*	*-*	*-*	*-*
Unused appropriations from previous years	***2.883.647***	***10.908.900***	***2.883.647***	***43.833.166***
Of which administrative	*2.883.647*	*3.908.900*	*2.883.647*	*3.943.983*
Of which operational	*-*	*7.000.000*	*-*	*39.889.183*

[43] This amount includes EUR 1.000.000 from SNS Joint Undertaking due to a joint synergy call. SNS has already provided EU-RAIL with EUR 500.000 i.e half of its contribution for the pre-financing payment of the concerned grant.

TOTAL ESTIMATE REVENUE	***114.575.205***	***87.920.687***	***114.575.205***	***120.809.870***

STATEMENT OF EXPENDITURE *(Commitment appropriations)*	***[Amended - A1] budget 2024 (AWP)***	***[Amended - A2] budget 2024 (AWP) after internal transfers***	***Executed Budget 2024***	***%***	***Available for future use (N+3 rule)***
Title 1 - Staff expenditure	***3.938.000,00***	***3.329.160,82***	***3.314.316,84***	***100,0%***	*14.843,98*
Salaries & allowances	*3.398.000,00*	*3.059.160,82*	*3.059.160,82*	*100,0%*	*-*
Mission expenses	*120.000,00*	*120.000,00*	*120.000,00*	*100,0%*	*-*
Training	*52.000,00*	*32.105,02*	*32.105,02*	*100,0%*	*-*
Other Staff related expenditure	*368.000,00*	*117.894,98*	*103.051,00*	*87,0%*	*14.843,98*
Title 2 - Infrastructure and operating expenditure	***1.545.000,00***	***1.793.339,18***	***1.775.622,79***	***99, %***	*17.716,39*
Rental of buildings and associated costs	*360.000,00*	*360.000*	*360.000,00*	*100,0%*	*-*
Information, communication technology and data processing	*195.000,00*	*155.000,00*	*151.742,20*	*98,0%*	*3.257,80*
Movable property and associated costs	*10.000,00*	*839,18*		*0%*	*839,18*
Current administrative expenditure	*15.000,00*	*15.000,00*	*15.000,00*	*100,0%*	*-*

Postage / Telecommunications	*15.000,00*	*15.000,00*	*9.398,85*	*63,0%*	*5.601,15*
Meeting expenses	*50.000,00*	*50.000,00*	*49.048,80*	*98%*	*951,20*
Running costs in connection with operational activities	*50.000,00*	*222.500,00*	*220.558,00*	*99,0%*	*1.942,00*
Information and publishing	*650.000,00*	*700.000,00*	*694.874,94*	*99,0%*	*5.125,06*
Other infrastructure and operating expenditure	*200.000,00*	*275.000,00*	*275.000,00*	*100,0%*	*-*
Title 3 - Operational expenditure S2R	***0,00***	***0,00***	***0,00***	***0,00%***	
Title 4 - Operational expenditure EU-RAIL	***106.195.392,00***	***75.024.048,00***	***75.024.048,00***	***100%***	
Unused appropriations not required in current year	*2.896.813,00*	***34.428.656,98***	*-*	*0,0%*	***34.428.656,98***
TOTAL	***114.575.205,00***	***114.575.204,98***	***80.113.987,63***	***70%***	*34.461.217,35*

STATEMENT OF EXPENDITURE *(Payment appropriations)*	***[Amended - A1] budget 2024 (AWP)***	***[Amended - A2] budget 2024(AWP) after internal transfers***	***Executed Budget 2024***	***%***	***Available for future use (N+3 rule)***
Title 1 - Staff expenditure	***3.665.000,00***	***3.775.000,00***	***3.347.867,01***	***89%***	*427.132,99*
Salaries & allowances	*3.230.000,00*	*3.250.000,00*	*3.059.160,82*	*94%*	*190.839,18*

Mission expenses	*100.000,00*	*100.000,00*	*63.594,75*	*64%*	*36.405,25*
Training	*35.000,00*	*25.000,00*	*13.484,40*	*54%*	*11.515,60*
Other Staff related expenditure	*300.000,00*	*400.000,00*	*278.602,66*	*70%*	*121.397,34*
Title 2 - Infrastructure and operating expenditure	***1.840.300,00***	***2.132.414,00***	***1.832.236,28***	***86%***	*300.177,72*
Rental of buildings and associated costs	*360.000,00*	*345.000,00*	*343.155,90*	*99%*	*1.844,10*
Information, communication technology and data processing	*205.000,00*	*248.000,00*	*247.277,00*	*100%*	*723,00*
Movable property and associated costs	*10.000,00*	*2.000,00*	*0*	*0%*	*2.000,00*
Current administrative expenditure	*10.300,00*	*14.071,00*	*11.487,36*	*82%*	*2.583,64*
Postage / Telecommunications	*15.000,00*	*10.000,00*	*3.544,23*	*35%*	*6.455,77*
Meeting expenses	*40.000,00*	*26.665,64*	*26.665,64*	*100%*	*0*
Running costs in connection with operational activities	*350.000,00*	*433.659,00*	*415.457,72*	*96%*	*18.201,28*
Information and publishing	*650.000,00*	*813.983,00*	*689.327,43*	*85%*	*124.655,57*
Other infrastructure and operating expenditure	*200.000,00*	*239.035,36*	*95.321,00*	*40%*	*143.714,36*

Title 3 - Operational expenditure S2R	***40.424.204,84***	***40.424.204,84***	***35.548.855,27***	***88%***	***4.875.349,57***
Title 4 - Operational expenditure EU-RAIL	***70.980.599,00***	***42.081.640,16***	***37.049.048,25***	***88%***	***5.032.591,91***
Unused appropriations not required in current year	***3.899.766,00***	***32.396.610,51***	***-***	***0,0%***	*32.396.610,51*
TOTAL	***120.809.870,00***	***120.809.869,51***	***77.778.006,81***	***64%***	*43.031.862,70*

At the year-end 2024, the JU had implemented 99,9% of its commitment appropriations made available in its active budget (Titles 1 to 4) and 69,9% for the total budget (Titles 1 to 5). The payment appropriations were implemented up to 87,9% (85,2,% in 2023) of the active funds (or 64,3% 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.

In GB Decision 16/2023 on 5 December, the EU-Rail Governing Board adopted the initial Annual Work Plan and Budget for 2024.

There were two amendments adopted to this document during 2024 with budget impact.

- **Amendment number 1**

The Executive Director proposed to the Governing Board adaptation of the Budget as per following:

Statement of Revenue

Compared to Work Programme 2024 and Budget, this amendment recognises and balance (Revenue and Expenditure) unused payment appropriations on S2R Programme operational expenditure due in relation to the previous budgetary years, in accordance with EU-Rail Financial Rules Article 6.5.

The following is entered in addition to the estimate of revenue:

- EUR 32.9 million in payment appropriations. Those will be needed for the last year of the S2R Programme execution in order to pay S2R Programme grants interim and final payments.

In 2023, the Reporting and Payments 2023 action plan forecasted 52 payments for the year with a total value of EUR 36 million, of which the JU achieved 42 payments for a total value of EUR 23.2 million. Of the 52 forecasted payments, 10 projects with a total value of 9,4m€ were postponed to be paid in 2024.

In 2024, the JU is forecasting for S2R Programme:

- 27 interim and final payments for a total amount of maximum EUR 36.6 million (including the 10 postponed from 2023);

- The possible complementary payments after final payments for 10 grant agreements (final payments in status "Actions under observations" in the IT accounting tool of the JU), for a maximum of EUR 3.2 million;

- Other final payments on tenders and experts.

The JU will deduct the amount already adopted by the Governing with initial budget 2024 as "unused appropriations of the year" of EUR 7.0 million. Consequently, the amount to be entered in addition to the estimate of revenue and in payment appropriations is EUR 32.9 million.

Statement of Expenditure

Title I and II: minor adaptation of the Budget appropriation per line was adopted considering the evolution of budget needs identified since the estimates made.

Title III (Operational S2R Programme): Increase of the S2R Programme operational payment appropriations of EUR 32,9 million. This was needed to pay the S2R Programme grants interim and final payments (and as applicable also final payments on operational tenders and experts) expected for the year 2024.

This was depending on the capacity of the projects to submit those payments on time and on the quality of reports and deliverables provided, and required a constant monitoring done by the JU with the projects' consortia.

This increase is covered by entering in addition to the estimate of revenue, the unused payment appropriations from the previous budgetary years.

- **Amendment number 2**

The Executive Director proposed to the Governing Board adaptation of the Budget as per following:

Statement of Revenue

All titles concerned (Administrative and operational budget):

Due to a clerical error in the JU's 2023 request for cash flow from the EC that was integrated at the operational and not administrative appropriations, with this amendment EUR 35.083 is added to the administrative unused payment to rectify the situation.

Statement of Expenditure

Title I and II:

Adaptation of the Budget appropriation (mainly in payment appropriations) per line is proposed considering the evolution of budget needs identified for the Quarter 2024 to maximise the consumption of the administrative budget, with the most important one the transfer between the salaries and allowances from staff of the establishment plan to external personnel due to different turnover in 2024.

Title III:

The amount of unused commitment appropriation as increased to a total of EUR 34.510.157, out of which EUR 31.613.344 from the operational EU-RAIL budget are transferred to the unused appropriations to ensure the financing of the 2nd wave call of Flagship Projects under the WP 2025-2026, as per multi-annual planning. EUR 32.396.611 of payment appropriations out of which EUR 28.496.845 from the operational EU-RAIL budget are transferred to the unused appropriations to cover future operational needs of the JU, as per multi-annual planning.

Implementation of the Budget

Administrative costs (Title 1 Staff Expenditure and Infrastructure and Title 2 Operating Expenditure)

Title 1 and Title 2 of the Budget were executed up to 99.4% in commitment appropriations, demonstrating a reliable budgetary planning.

Title 1 – Staff Expenditure was mainly used for the salaries of the JU staff. During the year, the JU also made use of external support, to fill the gaps during the recruitment process on staff turnover and to cope with the important workload on JU activities.

Title 2 – the administrative expenditure was mainly used to ensure the JU activities – in particular to cover the high number of communication events and the commitment for InnoTrans 2024.

The implementation rate of the payment appropriations was 87.7% (95% in 2023), showing a decrease in implementation of payment appropriation in relation to the previous budgetary year.

Title 3 and Title 4 Operational Expenditure

Title 3 of the Budget constitutes the JU's Operational Budget for implementation of the S2R Programme activities.

Title 4 of the budget constitutes the JU's Operational Budget for the implementation of the new EU-Rail Programme activities.

The majority of the JU's budget falls under this category representing 95% of the active (Titles 1 to 4) and 65% of overall budget (including Title 5). The proportion has stabilized compared to 2023 (92% in 2023) since EUR 74.4 million was available to be allocated to EU-Rail operational commitment appropriations this year, being the second year of the launch of activities under the EU-Rail Programme.

The budget category Title 3 covers the interim and final payments implementing the remaining grant agreements, operational procurement and expert fees incurred as part of the evaluation for the S2R Programme.

The budget category Title 4 covers the second instalment of the first Call for proposal of the JU for a total funding of EUR 232.4 million and launched with multi-annual instalment (EUR 135.7 million EUR of Commitment Appropriations (CA) used in 2022,EUR 55.9 million used in 2023 and 40.8 million used in 2024), a fourth Call for Proposal for Exploratory Research (for 21.7m EUR) and tenders for System Pillar activities and other tenders and studies.

The implementation rate of the operational budget in both commitment and payment appropriations was respectively 99.5% (100% in 2023) and 87.9% (85% in 2023). This year, a major portion of payment appropriations were used for the second pre-financing of the grants resulting from the 2023 and 2024 calls.

The reported implementation also includes payments to the Expert Evaluators which is managed by the European Research Executive Agency (REA) Services.

Title 5 Unused appropriations not required in current Year

The amount included under Title 5 – Unused appropriations not required in current year has been established to support a transparent implementation of JU Financial Rules Art.6.5, the so called n+3 rule. In accordance with the Financial Rules and the general practice of the JU, these appropriations will be reactivated in the future year budget(s) of the following year and used first.

The 2024 as finally adopted budget presents 34.5m EUR of unused operational and administrative commitment appropriations, and 32.3m EUR of unused payment appropriations that will be re-inscribed in revenue and expenditure in the following years. The reason for the high amount of unused appropriations both in commitments and in payments is to finance the 2nd wave of flagship areas' projects of 133.5m whose grant agreements will only be signed in 2026 and will be financed by these unused appropriations and the budgets from 2025 and 2026.

2.4. Financial and in-kind contributions from Members other than the Union

As not all the contributions included in the Single Basic Act as funding options for the activities caried out on various programs, are reflected in the financial statements of the Joint Undertaking, the below information aims to provide a comprehensive overview of the funding for the on-going programmes used.

The information provided combines contributions validated and estimated in an effort to breach the timing gap in the validation of the cash and in-kind contributions. In addition to the information on cash and IKOP presented the notes related to the net assets and liabilities, the below overview also includes information on the IKAA contributions which are not presented in the financial statements.

	Members' contributions					
Programme	EU cash (a)	Third Country Contributions (UK) (b)	Private members cash (c)	Private members IKOP (d)	Private members IKAA (e)	**Total (e)=(a)+(b)+(c)+(d) + (e)**
H2020	*450.000.000,00*		*13.500.000,00*	*336.500.000,00*	*120.000.000,00*	***920.000.000,00***
Horizon Europe	*586.000.000,00* [44]	*29.000.000,00*	*24.000.000,00*	*591.000.000,00*[45]		***1.230.000.000,00***

Members contributions as of 31.12.2024									
Programme	EU cash validated	EU cash not validated (PF)	Private members cash validated	Private members IKOP validated	Private members IKOP estimated	Private members IKAA certified	Private members IKAA estimated	**Total**	**Achievement rate**
H2020	*450.000.000,00*[46]	*0,00*	*13.500.017,03*	*362.138.533,10*	*0,00*	*267.618.770,86*	*0,00*	***1.093.257.320,99***	***119%***
Horizon Europe	*215.709.298,43*	*45.220.103,57*	*8.415.063,10*	*1.981.572,11*	*86.611.847,00*	*161.166.833,13*	*5.660.888,01*	***524.765.605,35***	***43%***

[44] The EU contribution for the Horizon Europe programme reflects the adjusted figure following the mid-term revision of the MFF

[45] The value of the Private members contribution to the Horizon Europe programme reflects the adjusted figure as per the GB decision 17/2023 on the commitment expressed by the private members to match a possible increase in the EU contribution following the association of the United Kingdom to the Horizon Europe programme

[46] The value of the EU cash for the Horizon 2020 programme includes also the EUR 52 million provided by the EU for the Lighthouse projects and approx. EUR 1.8 million of costs incurred before the financial autonomy of the Joint Undertaking.

Horizon 2020 programme

The information presented for Horizon 2020 represents the consolidated view over the financing of the programme during its full life cycle.

The achievement rate of 119% at programme level is mostly due to the IKAA contributions from the Private members. Overall, the EU has met its financing target while the Private Members have exceeded their financing target by 37% leading to an overall increase in financing of 19% above the target set for the programme. While the target for IKOP was exceeded by 8%, the main funding excess was registered in the value of the IKAA where the Private Members have exceeded the target by 137% providing more than the double funding foreseen for the programme.

Horizon Europe programme

The information presented for Horizon Europe includes the adjusted target for EU contributions, as amended through the MFF's mid-term revision and through the addition of third country contributions to the programme. The cumulative impact of these changes has led to an increase of EUR 15 million in EU funding towards Europe's Rail activities. The funding target for the Private Members has also been adjusted to match the EU contribution. The information presented for Horizon Europe is in line with the financing expectations from a programme that is approaching its maturity phase. The overall financing stands at 43% of the total foreseen EUR 1.200 million which is in line with the programme's implementation timeframe.

While looking at the adjusted contribution targets per member category, the total contribution of the Union stands at 42% against the EUR 615 million target and the Private Members contribution is estimated at 43% against the adjusted target of EUR 615 million.

The EU validated cash shows an implementation of 35% of the total expected funding of 615 million for the programme. On the Private Members' side, the confirmed implementation stands at 28% when considering the validated cash and IKOP together with the certified IKAA.

The comparable pace of validated contributions provided by the Union and the Private Members can be confirmed mainly following the timely certification process of the IKAA contributions. At the same time, the comparable contributions indicate a robust management of the grant calls and IKAA planning.

The in-kind contributions result from the activities carried out by the JU's members other than the Union, funded by the JU when in relation of awarded actions (IKOP) and/or not funded by the JU (usually Additional Activities and/or IKAA). They are not revenues in accordance with the budgetary accounting, hence they are not reported in the Budgetary tables and shall be excluded from any other purposes than the achievement of the SBA objectives.

Nevertheless, they constitute the essential component of the "partnership" nature of the Joint Undertaking.

2.4.1. Europe's Rail in-kind Contributions

The in-kind contributions to operational activities received from the EU-Rail Private Members in 2024 amount to EUR 1.981.572, this is justified as the programmes is in an early phase of its implementation. In-kind contributions to operational activities should be accounted for solely on the basis of eligible costs and should be reported and audited in accordance with the mechanism applicable to the specific grant agreement. Under Horizon Europe only validated and accepted contributions by the Executive Director can be recognised under net assets. Therefore, the same accounting treatment as used under the previous regulations is applied to IKOP under Horizon Europe.

Moreover, the in-kind contributions for additional activities that have been already certified for the years 2022 to 2024 is EUR 161.166.833. The status of the reported IKAA is in Annex G.

Values of certified IKAA – Evolution (in EUR)	
Year	**Amount of certified IKAA (in €)**

2021	*N/A*
2022	*30.724.997,98*
2023	*75.065.338,25*
2024	*55.376.496,90*
TOTAL since 2021	*161.166.833,13*

Cumulatively the EU-Rail private Members validated EUR 163.15 million of in-kind contributions, representing 27.61% of the amount of in-kind contributions to be realised for the for the EU-Rail Programme.

2.4.2. S2R in-kind Contributions

In accordance with Article 174 of the Single Basic Act, Europe's Rail JU (hereinafter EU-Rail) is the legal and universal successor of the Shift2Rail JU (S2R JU). The rights and obligations in relation to the Shift2Rail Programme, hence, remain applicable under the current legal framework.

In this respect, in accordance with article 4(3) of the S2R Regulation, "the members of the S2R Joint Undertaking other than the Union shall report by 31 January each year to the Governing Board of the S2R JU on the value of the contributions referred to in paragraph 2 made in each of the previous financial years".

Article 4(2) of the S2R Regulation establishes that the total contribution to be provided by the Other Members[47] and totalling EUR 470 million shall consist of:

IKOP[48] (in-kind contribution to operational activities): at least EUR 350 million, including at least EUR 200 million from the founding members other than the Union and their affiliated entities, and at least EUR 150 million from associated members and their affiliated entities. In accordance with Article 16(3)b of the S2R Statutes, IKOP consists "of the costs incurred by them [the S2R Other Members] in implementing indirect actions less the contribution of the S2RJU and any other Union contribution to those costs".

IKAA (in-kind contribution to other activities): of at least EUR 120 million, of which at least EUR 70 million from the founding members other than the Union and their affiliated entities, and at least EUR 50 million from associated members and their affiliated entities. These contributions shall consist of the costs incurred by them in implementing additional activities outside the work plan of the S2R Joint Undertaking, which are complementary to this work plan and contribute to the objectives of the S2R Master Plan. Other Union funding programmes may support those costs in compliance with the applicable rules and procedures. In such cases, Union financing shall not substitute for the in-kind contributions from the Members other than the Union or their affiliated entities.

The aforementioned in-kind contributions, which consist of financial expenditure executed by the Members – salaries, assets, operations, etc. – to achieve the S2R Programme and its Projects, are in addition to the cash contribution of the S2R Other Members to the 50% of the running costs of the JU.

S2R Other Members' reporting for 2023

The Other Members of S2R submitted their reporting on IKOP and IKAA to the JU by 31 January 2024.

The Lighthouse projects are excluded from this reporting as assimilated to open calls and within the administrative management of the European Commission. This report covers IKOP related R&I activities as from Sept 2016 till Dec 2023, which is the end period for the S2R Programme operational activities; in terms of IKAA the activities are considered eligible as from the date of acceptance by the Other Members of the S2R JU Statutes, by means of their respective letters of endorsement.

[47] The "Other Members" consist of the Founding Members of S2R, with the exclusion of the Union, and the Associated Members.
[48] As laid down in Article 16(2) and Article 16(3)(b) of the S2R Statutes.

In accordance with Article 4(4) of the S2R Regulation, the Other Members shall have the costs related to IKOP and IKAA certified by an independent external auditor appointed by the entity concerned.

IKOP and IKAA Certification

By the end of 2024, the S2R Other Members have provided the JU with audit certificates on the IKOP and IKAA costs declared for the year 2023. After due examination of the relevant certification and, in particular, the audit standards applied to the issuance of the "audit certificates", the acceptable corresponding IKOP contributions have been "validated" by the Executive Director and will therefore be accounted towards the obligation set in Article 4(2) of S2R Regulation to the S2R Other Members.

With regard to the Provisional Annual Accounts of EU-Rail:

- The last validation of the outstanding amount during the course of 2024 brought the value of the total validated IKOP to approx. EUR 362 million.

Additional information

IKOP

As indicated under the definition of IKOP, these costs represent the difference between the Total Project Value of S2R projects and the EU-Rail co-funding (or estimated).

In order to allow EU-Rail to be in the position to sign the relevant grant agreements, the Union provided the necessary Commitment Appropriations to match the S2R Programme co-funding of EUR 266.5 million above (excluding OC), against the S2R Other Members' commitment of EUR 362.1 million. In terms of Union Payment Appropriations, they were used to provide the pre-financing up to 45% till 2019 and 55% for the call 2020 (to maintain cash flow in the current economic negative situation created by the C-19 pandemic) of the estimated funding in accordance with the relevant provisions of the grant agreements. In 2021, only two projects were signed following the call 2021 with limited contribution and impact from the S2R Other Members'.

It should be noted that the estimated requested co-funding included in the 2021 Other Members' declarations is within the limits of the provision of the relevant Membership Agreements. In fact, Article 2.2 of each Other Member's Membership Agreement signed with EU-Rail establishes that "the Member agrees to limit its reimbursement request in indirect actions funded under Article 3(1)(a) of the S2R JU Regulation to an amount not exceeding 44.44% of the Member's total eligible costs in implementing indirect actions. In case of research and innovation activities delivering the expected results through a series of intertwined actions throughout successive S2R JU Annual Work Plans, and without prejudice to the provisions concerning co-funding rates established in the S2R JU Annual Work Plans, this 44,44% threshold shall be applied cumulatively taking into account the final amount of reimbursement requested at the end of the last action implementing the specific intertwined research and innovation activities".

Following the financial closure of the projects financed under the Shift2Rail programme, the S2R Other Members have outperformed their IKOP contribution certifying EUR 362.1 million, 8% above the regulatory obligation of minimum EUR 336,5 million (i.e. EUR350 million minus EUR 13.5 million of administrative costs). The percentage resulting from the cumulative reimbursement requests in all indirect actions for S2R Other Members at the end of the programme is 42.39%, within the maximum level of 44.44%.

The deviations observed from individual members in 2023, following the remedial actions during the final grant payments taken by the JU in 2024 have all been addressed and all S2R Other Members are within the maximum funding rate of 44.44% at the Programme closure.

IKAA

In terms of IKAA, the total contribution for the S2R Programme has now reached EUR 267.6 million, 123% above the regulatory obligation of minimum EUR 120 million.

At the end of the programme, based on the Projects' cost statements and the validation of the in-kind, the situation of IKOP

		TPC/IKOP REPORTING					
		TOTAL PROJECT COST			CO-FUNDING		IKOP
Other Members		AAR 2016 - AAR 2023	Programme TOTAL	of which CERTIFIED	AAR 2016 - AAR 2023	Programme TOTAL	AAR 2016 - AAR 2023
Alstom	Alstom(*)	51.073.211	51.073.211	***51.073.211***	21.473.478	**21.472.304**	29.599.732
Hitachi / Ansaldo STS	Ansaldo STS/ HITACHI RAIL STS	49.383.167	49.383.167	***49.383.167***	21.824.069	**21.824.069**	27.559.098
Bombardier Transportation	Bombardier Transportation	48.013.514	47.669.417	***47.669.417***	20.748.094	**20.754.319**	27.265.420
CAF	CAF(*)	40.361.319	40.361.319	***40.361.319***	17.377.544	**17.338.520**	22.983.775
Network Rail	Network Rail(*)	32.654.784	33.232.896	***33.232.896***	14.370.125	**14.726.272**	18.284.659
Siemens	Siemens(*)	47.555.274	47.555.274	***47.555.274***	22.039.161	**20.890.474**	25.516.113
Thales	Thales(*)	38.052.590	37.846.922	***37.846.922***	16.675.777	**16.649.723**	21.376.812
Trafikverket	Trafikverket	43.372.828	43.372.828	***43.372.828***	17.882.998	**17.886.802**	25.489.830
Founding Members		**350.466.687**	**350.495.034**	**350.495.034**	**152.391.247**	**151.542.484**	**198.075.440**
Aerfitec	Aerfitec	11.225.486	11.225.486	***11.225.486***	4.896.396	**4.896.396**	6.329.090
Amadeus	Amadeus	4.508.487	4.508.487	***4.508.487***	2.346.626	**2.370.702**	2.161.861
AZD Praha	AZD Praha	8.617.842	8.617.842	***8.617.842***	3.558.660	**3.558.660**	5.059.182
Competitive Freight Wagon	Competitive Freight Wagon	9.366.017	10.196.451	***10.196.451***	4.377.448	**4.377.448**	4.988.568
Deutsche Bahn AG	Deutsche Bahn AG	52.732.178	52.732.178	***52.732.178***	20.156.157	**20.000.713**	32.576.021
Diginext	Diginext(*)	6.449.699	6.449.699	***6.449.699***	2.811.570	**2.811.570**	3.638.129
EUROC	EUROC	7.390.187	7.390.185	***7.390.185***	2.747.525	**3.284.034**	4.642.662
Faiveley - Wabtec	Faiveley	17.541.942	17.541.942	***17.541.942***	6.647.763	**6.633.767**	10.894.179
Hacon	Hacon(*)	18.379.888	18.379.888	***18.379.888***	7.619.943	**7.670.965**	10.759.945
Indra	Indra(*)	28.469.450	28.469.450	***28.469.450***	12.665.609	**12.652.071**	15.803.840
Kontron - Kapsch	Kapsch	8.179.686	8.179.662	***8.179.662***	3.609.317	**3.595.173**	4.570.369
KnorrBremse	KnorrBremse	14.733.459	14.733.459	***14.733.459***	4.808.500	**4.808.191**	9.924.959
MerMec	MerMec(*)	8.750.813	8.750.813	***8.750.813***	3.855.409	**3.855.409**	4.895.403
SmartDeMain	SmartDeMain	12.520.693	12.683.750	***12.683.750***	5.454.843	**5.454.843**	7.065.850
SmartRaCon	SmartRaCon	13.492.837	13.489.528	***13.489.528***	6.132.008	**5.995.298**	7.360.829
SNCF	SNCF(*)	12.617.712	12.660.860	***12.660.860***	5.642.956	**5.626.611**	6.974.756
SWITRACKEN	SWITRACKEN	9.073.819	9.534.422	***9.534.422***	4.154.338	**4.087.513**	4.919.482
Talgo	Talgo(*)	11.838.816	11.838.816	***11.838.816***	4.864.619	**4.864.263**	6.974.197
Virtual Vehicle Austria Consortium VVAC+	Virtual Vehicle Austria Consortium VVAC	20.773.763	20.773.763	***20.773.763***	8.282.965	**8.427.070**	12.490.798
Associated Members		**276.662.774**	**278.156.680**	**278.156.680**	**114.632.653**	**114.970.697**	**162.030.121**
Total		**627.129.461**	**628.651.714**	**628.651.714**	**267.023.900**	**266.513.181**	**360.105.561**

Other Members	IKAA CERTIFICATION	
	Certified as at 1 June 2024	*Certified at the end of the programme*
Alstom	*11.912.418*	*11.912.418*
Hitachi / Ansaldo STS	*9.854.167*	*9.854.167*
Bombardier Transportation	*15.688.168*	*15.688.168*
CAF	*8.946.296*	*8.946.296*
Network Rail	*23.248.000*	*23.248.000*
Siemens	*10.950.000*	*10.950.000*
Thales	*26.936.033*	*26.936.033*
Trafikverket	*17.302.291*	*17.302.291*
Founding Members	***124.837.373***	***124.837.373***
Aerfitec	*2.279.671*	*2.279.671*
Amadeus	*17.496.678*	*17.496.678*
AZD Praha	*4.803.672*	*4.803.672*
Competitive Freight Wagon	*1.039.853*	*1.821.291*
Deutsche Bahn AG	*29.235.220*	*29.235.220*
Diginext	*2.078.801*	*2.078.801*
EUROC	*14.163.890*	*14.163.890*
Faiveley - Wabtec	*3.469.801*	*3.469.801*
Hacon	*18.872.992*	*18.872.992*
Indra	*5.426.000*	*5.426.000*
Kontron - Kapsch	*3.980.835*	*3.980.835*
KnorrBremse	*9.372.373*	*9.372.373*
MerMec	*2.667.013*	*2.667.013*
SmartDeMain	*5.054.040*	*5.088.942*
SmartRaCon	*3.590.462*	*3.598.650*
SNCF	*4.845.155*	*4.845.155*
SWITRACKEN	*2.569.446*	*2.569.446*
Talgo	*2.906.321*	*2.906.321*
Virtual Vehicle Austria Consortium VVAC+	*8.104.648*	*8.104.648*
Associated Members	***141.956.870***	***142.781.398***
Total	**266.794.243**	**267.618.771**

2.5. Administrative Procurement and contracts

In order to reach its objectives and adequately support its operations and infrastructures, the JU continued in 2024 to allocate funds by procuring the necessary services and supplies. In the interest of sound financial management the JU made, to the possible extent, use of Service Level Agreements (SLAs) with relevant Commission services and EU Agencies (such as in the field of ICT, training, payroll, mission, experts reimbursements, interim staff, etc.).

As it was the case in 2023 for the SLA implementing the back office arrangements for the accounting services with other JUs(EU-RAIL as lead JU), in 2024 EU-Rail signed an SLA implementing the back office arrangements for human resources (Circular Bio-based Europe as lead JU)with other JUs, continued implementing the SLA related to back office arrangements for procurement (Clean Aviation as lead JU) and negotiated a new SLA related to back office arrangements for ICT (Clean Hydrogen and Innovative Health Initiative as co-leads JUs).

EU-Rail did not sign in 2024 any new SLAs with European Commission services, only amendments to the existing ones to include additional services or to remove services that became obsolete.

In 2024 EU-Rail continued to participate in inter-institutional framework contracts (e.g.: IT, audit, office furniture, insurance, human resources services) by signing Memoranda of Understanding. In particular, to ensure synergies between the JUs, in 2024 EU-Rail continues to implement a Multiple Framework Service Contract in cascade (4 lots) for communication services between Clean Aviation (lead JU), SESAR and EU-Rail Undertakings. As indicated in section 1.4.2, EU-Rail continues to implement its framework contract for services related to support to programme management and legal assistance. At this regard, in order to ensure synergies between the JUs, EU-Rail – as the sole contracting authority- managed, signed and implemented specific contracts for other JUs, with the prior signature of SLA with those JUs to formalise the process and the transfers of amounts from the other parties to EU-Rail for the payment provided for in the specific contract (via "debit notes"). This approach was validated by the European Court of Auditors during the Audit of the annual accounts of the EU-Rail concerning the financial year 2022 and EU-Rail complied with the transparency requirements by publishing such specific contracts in the EU-Rail recipients of funds (see below).

In 2024 EU-Rail awarded a negotiated procedure without prior publication of a contract notice[49] and concluded a framework contract on 11/09/2024related to the provision of an EU Data protection online central register services for all Joint Undertakings. As the central register for the records of processing activities ("on-line register") is a common need to all JUs, including the newly created JUs, EU-Rail launched this procedure to extend the current supplies and services and included in the contract the newly created Joint Undertakings Global Health EDCTP3, the European High Performance Computing Joint Undertaking (EuroHPC JU) and the Smart Networks and Services Joint Undertaking (SNS JU). This tender procedure was included in the JUs' Joint Procurement 2024-2025 annexed to the Service Level Agreement related to the Back Office Arrangement for Procurement.

As the ongoing contractor, owner of the tool, detains exclusive rights, the supplies and services (onboarding, maintenance, training and support of the IT tool) can only be delivered by this service same provider in order to ensure the protection of intellectual property. Until now, no other internal or external alternative solution has been found that can guarantee a continuous service and a proportionate use of human and financial resources. The specific contracts resulting from this negotiated procedure will be published in the EU-Rail recipient of funds 2024 to meet the ex-post publicity obligations.

Where SLAs or FWCs were not available for specific services or supplies, the JU resorted to middle and low-value contracts. As indicated in the Amended Work Programme 2024, in 2024 EU-Rail launched several very-low value procedures (i.e.: below EUR 15.000) for e.g.: team building and trainings, subscriptions to journals and periodicals, catering services.

In accordance with Article 15 (Principle of transparency) of the EU-Rail Financial Rules the JU shall make available on its internet site no later than 30 June of the following financial year information on the recipients of funds deriving from its budget, including procurement contracts. In addition, as stated in point 3.3 of Annex I to the Financial Regulation 2018/1046 (which applies to the JU), EU-Rail, as a contracting authority, shall publish a list of contracts on its website no later than 30 June of the following financial year for specific

[49] Point 11(b) (iii) Annex 1 EU Financial Regulation - monopolistic situation.

contracts and order forms implementing a framework contract. The EU-Rail recipients of Funds and Annual List of Specific Contracts for 2023 are published at https://rail-research.europa.eu/participate/recipients-eu-rail-funds/.

In order to establish the maximum values of procurement contracts, where necessary, the JU makes use of the collective experience of its involved staff, its Members and experts, as necessary, driven by the principle of sound financial management. Although this was not formally documented in formal acts, audit trails are available also in the exchanges between the staff and the procurement sector to finalize the call for tenders before the approval by the Executive Director.

In 2024, for open procedures, the JU continued publishing them on the Funding and Tenders Opportunities portal (F&T)[50] with a link to EU-RAIL web site[51] and allowing the tender's submission exclusively via the electronic submission system (eSubmission) available from the F&T Portal. In the context of the eProcurement strategy, in 2022 EU-Rail started the on-boarding process of the Public Procurement Management Tool (PPMT), the tool that will replace TED e-notices and e-tendering. The on-boarding process finalised in April 2023. Open tender procedures that EU-Rail launched in 2024 were published using the PPMT tool.

During 2024 several guidance documents and templates for procurement procedures continued to be updated by the Chief Legal Officer (i.e.: calendar, tender specifications, opening and evaluation of tenders, award procedures for low value contracts, etc.) to adapt them to JU needs and to the DG BUDG recommendations, in particular to the e-submission and PPMT procedures. In addition, the register of framework contracts, SLAs and Memoranda of Understanding has been regularly updated to ensure a proper follow-up of the SLAs and FWCs in force.

In 2024, the register of procurement contracts built from ABAC legal commitment (LCK) continued to be updated. The "e-contract register" contains records of all JU's legal commitments (i.e.: "procurement contracts and grant agreements") and thus serves also as the source of data for publication of the "EU-Rail Annual Recipient of Funds, including all specific contracts implementing framework contracts" information on its website. The register also allows the monitoring of the JU's consumption of framework contracts.

2.6. IT and logistics

The JU's focus was on the core activities: since its creation, the JU has been one of the most active promoters of a single approach for all the JUs to the ICT environment, reducing costs, outsourcing, and increasing performance.

In this respect:

a. Use of European Commission applications and framework contracts

The JU has implemented common ICT tools designed and made available by the EC for the financial and call management. These tools are updated and maintained on regular basis by the EC; they require continuous input from the side of the JU, on the one hand, to correct the multiple and repetitive mistakes and, on the other hand, in terms of future developments to meet the expectations of the partnership. The follow-up of these processes absorbs multiple resources of the JU.

In order to ensure the correct usage and implementation of these applications, JU makes use of the training services offered by the EC on these applications.

For the execution of the calls for proposals, the IT systems were used throughout the entire process: for the publication of the call, for the submission and evaluation of the proposals as well as for grant preparation. The EC IT systems "e-submission/e-tendering" have also been used since 2020 by the JU for operational tender procedures.

In addition to the extended use of the Commission financial applications, the JU adopted the EC's ICT systems for HR (Sysper) and daily document management (ARES) to leverage the EC's proven working technology solutions already in place, but also to streamline and further harmonize the processes,

[50] https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/home
[51] https://rail-research.europa.eu/participate/procurement/ongoing-calls-for-tender/

workflows, procedures of record management, document archiving and electronic document cataloguing, secure storage and document access.

The JU continued to make use of the Commission's ICT framework contracts to procure all ICT services required to run its activities.

b. Use of European Agencies' framework contracts, including with or on behalf of other JUs

In addition, EU-Rail participates to the joint strategic ICT plan of the JUs located in the White Atrium building. Since 2018, EU-Rail shares its virtual IT infrastructure that is hosted by a private cloud computing provider and also shares the ICT managed services performed by a private company, in synergy with the other JUs. In 2020, the connectivity to the EC tools has also been migrated to this private cloud, which provides a full mobility and independence from the EU-Rail premises, and which proved to be very efficient during the Covid-19 pandemic. In 2020 and 2021, EU-Rail has also further integrated other agencies to benefit from these services, such as ERA, ELA, BEREC, etc., building upon a unique know-how of synergies' service model. In 2024, the connectivity to the EC tools was transferred to DIGIT as broker, now providing the connectivity as a service. As per the Regulation 2023/2841 on Cybersecurity that entered into force on 07/01/2024, EU-RAIL appointed a Local Cybersecurity Officer (LCO) reporting directly to the Executive Director to communicate with the Interinstitutional Cybersecurity Board (IICB).

In 2020, on behalf of all the JUs, the JU commissioned a Data Protection Impact Assessment (DPIA) and security risk assessment on the migration to Microsoft Office 365 public cloud environment, as required by the adopted EU regulation on the protection of personal data by EU institutions and bodies (Regulation (EU) 2018/1725). The DPIA identified the inherent risks that can be mitigated through a series of identified measures with the conclusion that the residual risks are qualified as "under control". Along with the progressive implementation of these mitigating measures, EU-Rail started in 2021 to migrate to Office 365 in synergy with the other JUs, first to Teams for meetings, then to SharePoint and OneDrive. The main Office 365 assets were migrated in 2022, starting with Exchange online as well as the document libraries in SharePoint, and Teams groups. The mitigating measures and migration for the other assets were implemented at end-2022.

2.7. Human Resources

2.7.1. HR Management

In 2024, no new Staff Implementing Rules (SIR) were adopted. The adoption of the new Decision on Working Time and Hybrid working, and its' adaptation to the specificities for EU-Rail was adopted in 2024.

In line with the Establishment Plan, recruitment procedures are launched and finalized as needed in order to recruit and replace departing statutory staff. At the end of the year, EU-Rail was staffed with 29 staff members including 2 Seconded National Expert (SNE). The occupational rate for statutory staff was 91%, due to the vacant posts of Head of Innovation Pillar, Internal Control Coordinator and Human Resources Officer. In 2025, the JU's authorized staffing will be 33 (incl. 3 CA posts for the Back Office Arrangement where EU-Rail provides Accounting to all JUs and 1 TA post financed from external revenues).

In 2024, four recruitment procedures were launched for the following positions and all finalised with a recruitment by the time of the adoption of this report:

Title	Contract type	Grade
Head of Innovation Pillar	TA	AD9
Internal Control Coordinator	CA	FGIV
HR Officer	CA	FGIV
SNE Research and Innovation	SNE	-

Furthermore, the incumbents for the recruitment procedures in 2023 for the posts of Head of Corporate Services TA AD10 and Accounting Assistant CA FGIII also started in 2024, on 01 July 2024 and 01 January 2024 respectively.

In addition to statutory staff members and the SNEs already in place, EU-Rail made recourse to 4 Interim Staff due to the vacant posts and other leaves and made use of the European Commission's Bluebook scheme to hire trainees.

Further details on the staffing are provided in the Staff Establishment Plan in Annex B.

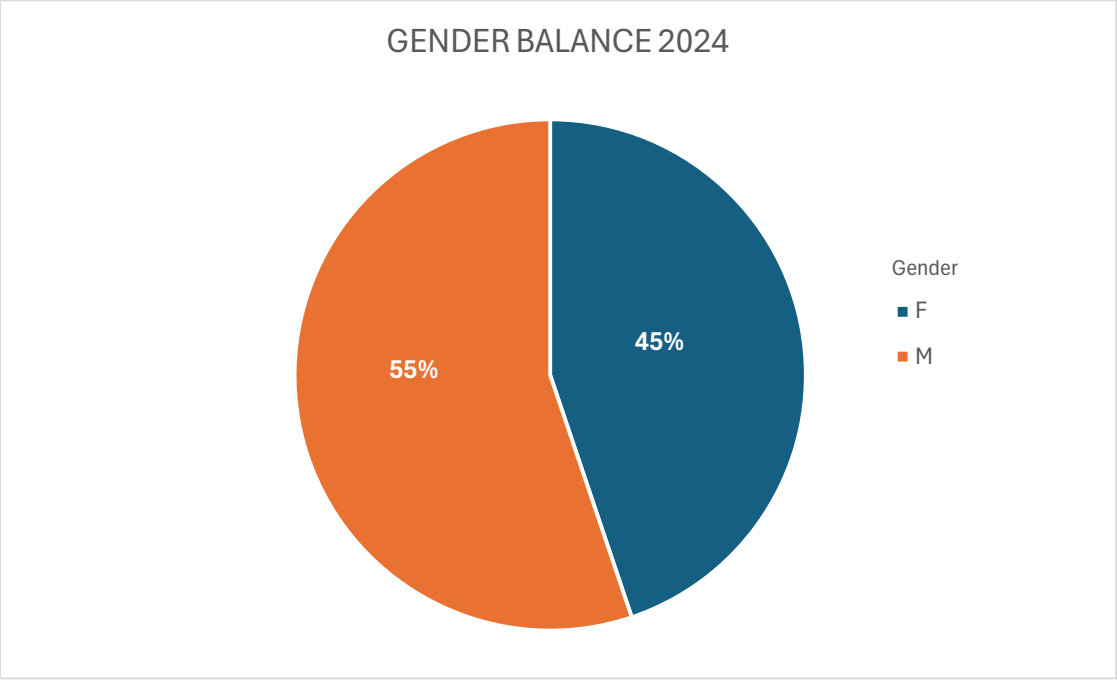
In addition to recruitment activities, the EU-Rail HR Officer ensured the conduct of the day-to-day personnel-related administration not covered by the Commission central services and continued to ensure improvement of all HR processes and to develop its internal guidelines, policies, and legal framework, paying particular attention to how EU Staff Regulations' Implementing Rules shall apply to the JU's particularities (in accordance with Article 110 of the EU Staff Regulations).

Annual appraisal and reclassification exercises were set up by HR within the limits of the Staff Establishment Plan and the EU-RAIL Financial Rules.

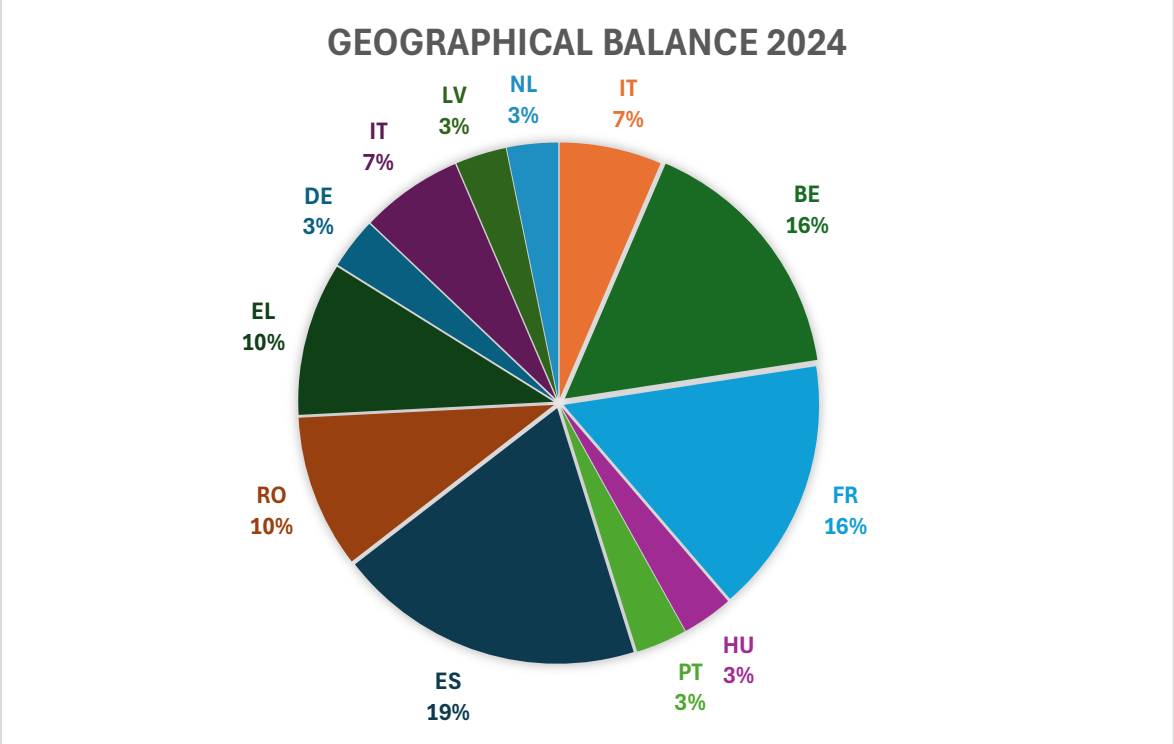
In line with the applicable Decision on working time and hybrid working, EU-Rail ensured on a continuous basis a good working environment and team spirit. For this purpose, social events and team building activities were proposed on a regular basis. In-house trainings/info sessions were also developed and proposed to staff with regard to HR-related aspects. Synergies with other JUs were exploited in terms of training, with colleagues participating in trainings dedicated to Ethics and Integrity and to Prevention and Detection of Fraud.

The JU also continued to implement its action plan resulting from its last staff survey. A fit-for-purpose organisational structure with clear roles and responsibilities was designed and the EU-Rail Governance and Process Handbook was adapted in light of the changes to the organisation structure and governance, reflecting the new Programme content and processes.

In 2024, the gender representation in the JU was as follows:



Geographical balance:



2.7.2. Efficiency gains and synergies

In 2024, the JU's major challenge was to continue in the successful and smooth transition towards the new EU-Rail Programme.

From the HR perspective, EU-RAIL is committed to ensuring the well-being of staff and that every staff member reaches their full potential. Trainings were strongly encouraged, and staff events were organised on regular basis in order to reinforce the cohesion of the team, the staff engagement and motivation.

In 2024, the JU defined priorities among these topics and continue the implementation of an action plan and indicative timeline for each one of them. In order to ensure synergies and efficiencies are exploited, the EU-RAIL HR ensured close collaboration with the Network of JUs' HR officers. In detail, EU-RAIL optimised synergies and efficiency gains by sharing reserve lists to shorten time to recruit, providing expertise and resources for selection procedures of other JUs and contributing to the development of a common legal framework among JUs by sharing ED and GB decisions on diverse regulatory topics.

In terms of operational efficiencies, EU-Rail was the first body of the Union together with the Commission to introduce since 2018 the Lump Sum form of granting. Based on the experience acquired and in line with the overall targets of Horizon Europe, the lump sum approach is the primary implementation way of the Programme. This will provide opportunities to focus the resources on added value functions, in particular on the cost effectiveness of the projects towards achieving the EU-Rail Programme results.

In terms of synergies and collaboration with the other Joint Undertakings, the Single Basic Act[52] establishes that the JUs shall achieve synergies via the establishment of back office arrangements (BOA), operating in some identified areas and by concluding service level agreements (SLAs). The SBA also underlines that these synergies should be implemented where screening of resources has proved to be efficient and cost-effective, while respecting the autonomy and the responsibility of each Authorising Officer.

[52] Article 13, Council Regulation (EU) No 2021/2085, of 19 November 2021

In order to obtain an independent view on the possible synergies among the JUs and the impact in terms of efficiencies, the JUs contracted an external consultant to perform a study on BOA. The study was finalised in July 2022 and the JUs identified and decided to implement from 2022 and 2023 the preferred model for the back office arrangements considering a setup with one JU taking the lead dealing in coordinating tasks with one backup JU, organising the work among staff of several JUs and having a clear scope and decision-making power, as was used in BOA for the provision of accounting services (following DG BUDG decision to terminate the respective contract with the JUs).

For some synergies, a more flexible option was chosen, with collaboration involving only some JUs, while remaining open for the others to join at a later stage.

The preparation work led to establishment of coordinated plans, prioritising those aspects of the BOA that had the objective to bring most value in the short term. These included, as top priorities, (i) the accounting function (ii) IT deployment (iii) joint procurement opportunities and (iv) HR support. These topics encompass 4 of the 7 synergies as per SBA Article 13. This approach was endorsed by the respective JUs Governing Boards.

When these arrangements were presented, the respective JUs Governing Boards stressed the need to have a balanced approach to the BOA implementation ensuring, as a priority, the execution of JUs' core businesses (ensuring budget execution and call implementation) which is very challenging in the context of a new programme with new legislation, new actors and ambitious timelines due to the delayed launch of the Horizon Europe programme.

The BOA that were put in place between 2022 and 2024, or submitted for proposal for implementation, were:

AREA	CONTENT	LEAD JU
Accounting	Accounting services	EU RAIL JU
ICT	ICT services	Clean Hydrogen JU
HR	Common Recruitment, HR Legal framework and HR digitalisation	CBE JU
Legal	Administrative procurements	Clean Aviation JU

In detail, those BOA were put in place or submitted for proposal through the following action plans:

- **BOA for Accounting Services**

The JUs took over the Accounting services that until 30 November 2022 were provided by DG BUDG and succeeded in implementing the BOA for Accounting Services in 2022, and immediately for the accounting closure 2022.

EU-Rail is the lead JU of this BOA and concluded the SLA with the other JUs on 16 December 2022. Accounting services will be provided by 3 Accounting Officers coming from the following JUs: CA JU, SESAR JU and EU-Rail JU.

Organisation:

- The Executive Director of the Lead JU is responsible for the organization, oversight and coordination of the accounting services to the other JUs on the basis of an annexe of the BOA SLA.

- The Head of Corporate Services or another officer with the necessary grade, skills and competencies of the Lead JU shall act as Accounting Coordinator of the BOA Accounting Officers.
- The Accounting Officer(s) of the JU Accounting Providers delivers the service to one or more JU Accounting Beneficiary and is responsible for the accounts she/he signs off, while counting on the support and coordination with the lead JU.

In order to ensure the provision of these services, it was agreed between the EC and the JUs to make use of the support of 3 additional Contractual Agents and of an external Accounting Services provider.

The BOA for Accounting services are fully operational and are delivering the intended services, including the preparation of the Provisional and Final Annual Accounts for 10 Joint Undertakings and liaising with the audit teams on accounting matters, the follow-up on the collection of Accounts Receivable past the due date, the VAT reporting towards the Belgian authorities, the annual validation of the accounting system, the inscription of the budget etc.

During 2024, BOA Accounting ensured the business continuity of its services and prepared the provisional accounts for the 10 JUs in a timely manner while receiving already a clean opinion for 9 out of 10 JUs by the European Court of Auditors.

During 2024, the BOA accounting has also provided on request ad-hoc support for the implementation and update of financial systems and financial processes.

As of January 2024, the BOA team is composed of 3 Accounting Officers supported by 3 Accounting Assistants.

- **BOA HR**

Article 13 of the Single Basic Act identifies Human Resources Support among the areas for common back-office arrangements. The CBE JU has taken the lead alongside IHI JU in setting up the BOA HR.

The BOA HR implements actions in three main areas of HR Support: recruitment, HR legal framework and HR digitisation. Its objectives are to maximise synergy among the JU's, harmonise procedures by valorising best practices, ensure coherent HR support services, achieve efficiencies and economies of scale and increase the negotiation power of JU's operating under the SBA with contractors and service providers.

The signature of the SLA, under the lead of CBE JU, took place on 03/04/2024.

In 2024, under the HR BOA, the Joint Undertakings have continuously maximised their synergies and have implemented several actions in three HR main areas: selection and recruitment, HR legal framework and HR digitisation. In particular, by holding bi-monthly meetings the JUs have continued to promote best practices, ensure consistent HR support services, and achieve efficiencies and economies of scale.

In line with the HB BOA action plan 2024, the JUs have:

- Implemented a common online assessment solution for remote proctoring services to support the running of written tests as part of selection procedures. To this end, a SLA among JUs was signed in September 2024 to proceed with the purchase of the above-mentioned services;
- Launched a series of workshops to align and harmonise the selection recruitment procedures practices among JUs;
- Strengthened their cooperation by:
  - organising an HR Officers Away Day to share best practise and shape collaboration;
  - sharing reserve lists to shorten time to recruit;
  - providing expertise and resources allowing staff members to be panel members in several selection procedures at other JUs;

- supporting new joint undertakings during their on-boarding/start-up phase, providing guidance, advice and templates;
- centralising the organisation of training courses of general interest for all JUs (e.g., ethics and integrity, antifraud, respect and dignity at the workplace for JU staff members, cybersecurity training courses for JU staff);
- contributing to developing a common JU HR legal framework by sharing Executice Director and Governing Board decisions on diverse HR regulatory topics;
- Launching by the CBE JU as lead of the new call for confidential counsellors to reinforce the network with additional confidential counsellors.

The JUs, as interinstitutional partners, have also attended meetings held by the European Commission on the HR transformation programme that intends to set up a new IT platform to replace SYSPER.

- **BOA ICT**

The ICT area covers a list of ~50 services (service catalogue) structured in 6 service groups:

1. Inter-JU IT Governance,
2. Management of shared ICT infrastructure,
3. Management of ICT tools, services and contracts,
4. Workplace services provision,
5. Security and compliance management,
6. ICT activities specific per JU.

The underlying concept is that, out of the ICT service catalogue, everything that is non-specific to a JU should be managed through the ICT BOA. Therefore, ICT developments and other activities specific to each JU will be under the responsibility of each ED and will not be part of the ICT BOA, that in any case will have to ensure the integrity of the overall ICT architecture.

Following the formal proposal for BOA in the area of information and communication technologies sent by the Clean Hydrogen JU to the Executive Directors of the Joint Undertakings, on 20 December 2023, EU-Rail expressed interest in joining this BOA.

The Clean Hydrogen JU and the IHI JU co-lead the BOA ICT, which continues the common approach to ICT services before 2024, referred to as 'pre-BOA' for ICT.

In 2024, in continuation of the practice over the previous years, the JUs held 4 ICT coordination meetings (called "IT gov meetings"), during which:

- The implementation of the common ICT annual work plan and budget for 2024 (AWP2024) was monitored.
- The common ICT annual work plan and budget for 2025 (AWP2025) was defined, with an adoption during the meeting of November 2024.

The AWP2024 contained the following 7 actions and related budget:

Action 1. Back-office IT (BOA) implementation

- The service level agreement for the BOA ICT was approved in November (see below)

Action 2. Common infrastructure migrations

- The migrations for the IaaS and Testa secured connection were finalized in March.

Action 3. Upgrade of AV Equipment in Common Meeting Rooms

- The MoU with OIB for audio-visual services was signed in September and the choice of design for the meeting rooms to equip agreed in December.

Action 4 Cybersecurity – data protection – Infosec regulation

- The common BCP has been revised and approved.

Action 5. EULogin integration with M365

- This action was dropped with the lack of maturity/availability of the DIGIT solution.

Action 6. SaaS O365 assets

- The SLA was signed in December amongst the JUs to launch a request for services for a revised M365 DPIA. The leadership of this project in 2025 is ensured by the DPO network supported by the ITOs.

Action 7. reconversion White Atrium building

- A disposal exercise for IT equipment was organised in each JU with centralization and common pick-up
- New equipment was implemented on the 1st floor to accommodate SNS JU and Global Health EDCTP3 JU with optic fiber and wi-fi antennas
- UPS renewal project was launched in December with installation in Q1 2025

In parallel, the JUs drafted the Service Level Agreement and Description of Services, describing the services to be provided under the BOA ICT in accordance with the priorities set forth in the BOA ICT concept note adopted by the Governing Boards in early 2024, namely:

- Service area #1 Inter-JU IT Governance,
- Service area #2 Management of shared ICT infrastructure and Service area #4 Workplace services provision,
- Service area #5 Security and compliance management

The SLA and Descriptions of Services were signed by the EDs of 10 Joint Undertakings until the end of 2024, paving the way for BOA ICT implementation, fully in accordance with Article 13 of the SBA and continuing the shared practices of the past 14 years as from 1st January 2025.

- **BOA Procurement**

This BOA has been established with the objective of centralising administrative procurement capability and process to maximise open tenders for award of inter-JUs FWCs and middle value negotiated procedures.

The BOA procurement was presented to the GB during its 8th meeting on 23 June 2023 and the GB approved the Back Office Arrangements –Procurement by written procedure on 28 July 2023[53].

On this basis a Service Level Agreement was drafted by the BOA Procurement Coordinator (CA JU) and concluded on 8 November 2023. EU-Rail, as back-up JU, actively participated in 2024 in the implementation of this SLA. The concept is supported by a bi-annual Joint Public Procurement Planning reflecting the common needs identified by the Parties. The focus is on the critical joint administrative procurement such as ICT, building management/corporate services and common support services that will be identified and agreed via joint Public Procurement Planning (PPP).

Although the primary objectives of the BOA procurement concept were to centralise administrative procurement capability, enhance the synergies among the JUs and increase their operational efficiency, a closer cooperation across 2024 proved that, despite limited resources, the JUs managed to quickly establish an effective mechanism of a joint services' model.

[53] Governing Board Decision n°12/2023

3. GOVERNANCE

3.1. Major developments

With the Europe's Rail Joint Undertaking going live after the SBA came into force, several new elements with regard to the organisation and governance of the JU were implemented, reflecting the design of the new EU-Rail Programme built around the two Pillars (the System Pillar and the Innovation Pillar) reinforced by a High-level Deployment Group (DpG) set up in 2024, and including the integration/adaptation of the European DAC Delivery programme in the new structure. The Governing Board Decision n° 17/2024 on the Work Programme 2025-2026 (adopted at the Governing Board meeting of 21 November 2024) included a new EU-Rail organisation structure in force since 1 of January 2025 (see Annex A).

Further details on EU-Rail's current governance and organisation are available by means of its Governance and Process Handbook.

3.2. Phasing-out Plan monitoring

EU-Rail adopted in November 2024 by means of the respective GB Decision[54] its revised Phasing-out Plan reflecting on the fact that the Joint Undertaking is set up as a Union body for a period ending on 31 December 2031 and financed under the EU multiannual financial framework 2021-2027. EU-Rail phasing-out plan includes the administrative and operational adaptations needed for a 'winding-up procedure', and the necessary steps, including procedural and process aspects, to complete the phasing-out of the Join Undertaking from Horizon Europe funding. In accordance with Governing Board Decision N°14/2023[55], the other elements of the phasing-out plan related to short and long-terms targets, strategic alignment, and the future financial stability should be further completed during 2024. The revised Phasing-out Plan included those elements.

EU-Rail has closely follow-up and actively contribute to the discussions among the relevant stakeholders regarding the future of the EU partnerships in the area of Research and Innovation and their possible extension for the next EU multiannual financial framework, leading to the publication of the draft high-level paper and will continue in 2025.

3.3. Governing Board

In accordance with the Single Basic Act, the Europe's Rail Governing Board (GB) continued its work steering the Joint Undertaking through the adoption of decisions to be implemented and executed by the Executive Director. Three ordinary and two extraordinary meetings of the Governing Board were convened in 2024. These GB meetings dealt with both operational and administrative aspects. Below is a selection of the most important GB decisions:

The 10th GB meeting (9 April 2024) approved the Back Office Arrangements (BOA) for information and communication technologies; and the list of actions selected for funding under the EU-Rail's call for proposals HORIZON-ER-JU-2023-01.

The 11th GB extraordinary meeting (26 April and 22 May 2024) was dedicated to the selection process of the Executive Director, which concluded with the appointment of Mr Giorgio Travaini as the new EU-Rail JU Executive Director.

The 12th GB meeting (21 June 2024) approved the revised Europe's Rail Multi Annual Work Programme (MAWP); the launching of a call for expression of interest with a view to selecting associated members with the potential to contribute to the achievement of the objectives of EU-Rail; the Consolidated Annual Activity Report (AAR) 2023; and the Final Accounts 2023, including the Budgetary Implementation Report 2023.

The 13th GB extraordinary meeting (17 July 2024) approved the ranked lists of innovation actions selected for funding under the EU-Rail's call for proposals HORIZON-ER-JU-2024-01.

[54] https://rail-research.europa.eu/wp-content/uploads/2024/11/GB-Decision_18-24_Rev_Phase_out_plan.pdf.
[55] https://rail-research.europa.eu/wp-content/uploads/2023/12/GB-Decision_14_2023_phase_out_plan.pdf

The 14th GB meeting (21 November 2024) approved the amendment N° 2 of the Work Programme 2024; the Work Programme 2025-2026; as well as the second version of the Phasing-out plan.

The Executive Director regularly provided at each GB meeting with an update on the different activities ongoing, such as the System and Innovation Pillars, the Deployment Group and the DAC Delivery Programme and overall Programme status, as well as the foreseen calls for proposals/tenders. He also reported on the administrative conclusion of the S2R programme status. He specifically informed GB Members on the progress in the setting up of EU-Rail's High-level Deployment Group (DpG); the selection process of applicants as a result of the EU-Rail's call for expression of interest with a view to selecting associated members (technical assessment concluded by mid-December 2024); and the outcome of the workshops on the future of the JU held during the year, including a presentation of the next steps which were the preparation of a high-level paper and a roadmap to deeper content developments for 2025.

In addition, the Executive Director regularly informed GB Members of the main communication and dissemination activities prior to each meeting, as well as those planned in the next months.

In every GB meeting, the ED referred to the deliberations and opinions provided by the advisory bodies SRG and SSG during the year.

The third General Assembly was organised on 21-22 November 2024. According to Article 93.5 of the SBA, the GB shall meet once a year in a General Assembly and all participants to the research and innovation activities of EU-Rail shall be invited to attend.

3.4. Executive Director

According to the SBA the Executive Director (ED) is the Chief Executive Officer responsible for the day-to-day management of the JU in accordance with the decisions of its GB and being accountable to the GB. The ED is the legal representative of the Joint Undertaking. He is supported in performing his duties by the the Head of Corporate Services, the Head of System Pillar Communication and Outreach, Head of Innovation Pillar as well as by all JU staff organized in the Programme Office.

In 2024, the Executive Director continued to make use of the dedicated advisory body - the ED System and Innovation Programme Board (ED-SIPB). The ED is accountable to the Governing Board and the ED-SIPB provides advice and support to the former, focusing on strategic exchanges on the Innovation and System Pillars and now also on Deployment Group activities, their evolution, and interdependencies as well as strategic guidance and recommendations with regard to the management of integrated Programme and its progress.

Mr Giorgio Travaini was appointed by the EU-Rail Governing Board[56] as Executive Director of Europe's Rail Joint Undertaking on 22 May 2024 for a period of four years, that can be renewed. Before this posting, Mr Travaini served as Executive Director ad interim and acting Executive Director as well as Head of Programme of Europe's Rail and Head of Research and Innovation in the predecessor programme Shift2Rail since 2015.

3.5. States' Representatives Group

Under the Europe's Rail Programme, 30 countries nominated representatives to the JU's State Representatives Group (SRG).

During 2024, the SRG held three meetings. In each of them participants were informed in detail by the ED about the ongoing and planned activities of the JU, including status of the Programme, as well as the foreseen calls for proposals. SRG Members were regularly updated on the System and Innovation Pillars, the European DAC delivery programme, Deployment Group and the communication and dissemination activities of EU-Rail.

In its first meeting of 28 February 2024, the SRG could deliberate on the draft Work Programme 2025-2026 and draft update Multi-Annual Work Programme. The ED also informed SRG Members on the stuts of setting up of the High-level Deployment Group (DpG); the expression of interest for the DAC pioneer trains;

[56] https://rail-research.europa.eu/wp-content/uploads/2024/05/GB-Decision_07-24_Appointment-ED.pdf

and the preparation work for launching the call for expression of interest for the enlargement of EU-Rail's membership.

During the SRG meeting of 14 May 2024, the SRG provided contributions on exploratory research for the Work Programme 2025-2026; and a positive opinion on the draft update Multi-Annual Work Programme and draft Annual Activity Report (AAR) 2023.

The last meeting of the year was held on 9 October 2024 and served to present SRG Members the outcome of the call for proposals HORIZON-ER-JU-2024-01 and have a discussion on the future of the JU and FP10 on-going consultations. A detailed report on the Flagship projects for the first year was also presented. The ED informed SRG Members on the amendment of the Work Programme 2024, which referred mainly to budget adjustments, including the IKAA plan updates. The SRG was invited to provide its opinions on the Work Programme 2025-2026 and on the Phasing-out plan, which were positive.

In each meeting, the SRG Members were requested to provide/update their national lists of R&I activities, in preparation of the end of the year report to be presented at the General Assembly, in according with the Single Basic Act.

The SRG also held an extraordinary meeting on 6 February 2024, which served to discuss and agree upon a list of conclusions which were formally adopted at its regular meeting of 14 May 2024.On the same date, the SRG also held a joint meeting with the SSG on the principles of cooperation and coordination activities between the two groups, which was followed by a proposal for collaboration presented by the SRG Chair to the SSG in its meeting of 26 September 2024.

3.6. Scientific Steering Group

The SSG is an advisory body to the JU composed of 12 renowned scientific experts, focusing on the long-term research and on identifying scientific and technological achievements and development priorities. The SSG held three meetings in 2024.

The Members of the SSG were equally informed by the ED – as for the SRG - on a regular basis of the developments in the EU-Rail Programme and the JU activities, including calls for proposals.

In the SSG meeting of 20 February 2024, the ED informed the members on the first amendment of the Work Programme 2024 to shift part of the budget appropriations from last year to 2024 for the completion of the pending payments of S2R projects. He also informed on the plans to launch a call for expression of interest in view of enlarging EU-Rail's membership. The SSG was invited to provide initial scientific advice about the early draft Work Programme 2025-2026 and the update of the Multi-Annual Work Programme. In the latter case, they were requested to brainstorm in particular on possible areas of priority.

In its meeting of 15 May 2024, the SSG Members provided positive scientific advice on the updated Multi-Annual Work Programme and on the draft Annual Activity Report (AAR) 2023. The SSG Members were also invited to propose scientific priorities to be addressed in the Work Programme 2025-2026, including on scope of next calls for proposals, in line with the EU-Rail's Master Plan. With regard to the call for expression of interest in view of extending EU-Rail's membership, the SSG, in line with Article 21.7.d) of the SBA, agreed to offer the GB its independent advice and scientific analysis if needed.

The last meeting of the year was held on 26 September 2024 during the InnoTrans Fair in Berlin, in which the ED presented the results of the EU-Rail call for proposals HORIZON-ER-JU-2024-01; and the activity of the High-level Deployment Group (DpG) throughout the year. The SSG Members were invited to provide their scientific advice to the last version of the drafts Work Programme 2025-2026 and Phasing-out plan, which was positive.

3.7. Deployment Group

As per Article 97 of the Single Basic Act, the Deployment Group is to advise the Governing Board on the market uptake of rail innovation developed in EU-Rail and to support the deployment of innovative solutions. The Deployment Group shall provide recommendations on issues related to the deployment of rail innovative solutions upon the request of the Governing Board. The Deployment Group may also issue recommendations on its own initiative.

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

to make recommendations to the various actors in the system on the deployment of innovative solutions that require high levels of coordination.

During 2024, following Governing Board Decision No. 11/2023, EU-Rail organized and completed the setup of the High-Level Deployment Group.

Members, associations, and State representatives nominated candidates to attend the High-Level Deployment Group. After assessing the nominations, a dedicated independent evaluation team composed the Group.

The first meetings in 2024 had an informal character due to the fact that the EC had not yet made a final decision on the composition and in agreement with the EC. On 29th November 2024, the European Commission made a final decision on the composition, structure, and list of candidates to become Members of the Deployment Group in accordance with Articles 22 and 97 of the Single Basic Act. DG MOVE (C(2024) 8368 final, 29.11.2024).

In the first formal meeting in 2025, all documents and informal decisions will be formalised, given the current legal status.

The current members of the high-level deployment group are: ADIF, AERRL/Nexrail, ALE, Alstom, CAF, CER, DB, EIM, FSI, Hitachi Rail, Knorr-Bremse, Norwegian Railway Directorate, OEBB, Siemens, SNCF, SRG (Portugal), Thales, Trafikverket, UIC, UNIFE, Voestalpine, DG MOVE, and EU-Rail. ERA and the ERTMS coordinator attend as observers. New members are expected to join thanks to the open application platform that EU-Rail launched on its website (at the beginning of 2025, following the formal setup and adoption), transparently also sharing the output of the groupwork : https://rail-research.europa.eu/participants-deployment-group/ . Twice a year, an assessment will be made for new members, following the Rules of Procedure.

Three informal meetings were held in 2024: a kick-off meeting and two meetings on procedures and the first topic (FRMCS). In these meetings, the RoP, communication plan, rules for appointing subgroups, 2-pager HL DpG and ERTMS stakeholder platform and the remits for the first subgroup on FRMCS were discussed and informally decided. Formal decisions will be taken in the first—now formal—meeting of 2025.

The High-Level Deployment Group discussed the main objectives of the Group, how to avoid duplications in work performed by other groups (e.g., ERTMS Stakeholder Platform), and the topics that need coordination at the EU level. It was agreed that FRMCS would be the first topic to focus on in a subgroup. The remits for the FRMCS subgroup were approved by the High-Level Deployment Group.

A dedicated subgroup was set up for European FRMCS Deployment. For this group, remits and a working plan were discussed and set as the basis for the work. Five informal meetings of the FRMCS subgroup were held in 2024. Three working groups were set up:

1. WG Technology

2. WG Legal and Finance

3. WG Migration and Alignment

A management team to steer the European Deployment activities, coordinators to lead the working groups and experts were appointed (all on voluntarily basis). Support is given by the EC DMT contract and EU-Rail resources.

3.8. System Pillar Steering Group

As per SBA Article 96, the System Pillar Steering Group (SPSG) is responsible for providing advice to the Executive Director and the Governing Board on:

- the approach to operational harmonisation and the development of system architecture,
- the detailed annual implementation plan for the System Pillar in line with the work programmes adopted by the Governing Board,
- monitoring the progress of the System Pillar.

Domain Teams and Core Group are preparing decisions to be validated at the System Pillar Steering Group and Governing Board levels.

The SPSG is composed of the following members:

- Chair: DG MOVE
- Members: Commission (DG MOVE and DG RTD), EU-Rail, Chairperson of the States Representative Group, ERA, ERRAC, AllRail, CER, EIM, UNIFE, UITP, UIP
- Observers (technical bodies responsible for providing advice to members): EUG, UIC, UNISIG, UNITEL
- Observers (other): ERTMS Coordinator, EPF, EUSPA, ETF, NB-Rail, RNE

During 2024, the SP Steering Group has given strategic direction and consent on the following topics in the several meetings held throughout the year:

- SP STG Meeting 8
  - Information and discussion about EU-RAIL Standardisation and TSI Input Plan
  - Information and discussion about analysis of Variants for European (CMS &) TMS
  - Information about approach to Harmonised Diagnostics
  - Information about Cybersecurity
  - Discussion about response to CER/EIM paper
  - Response on Year 1 of the System Pillar
  - Information about EET/SPMM Achievements (Glossary)
- SP STG Meeting 9
  - Approval of the EU-RAIL Standardisation and TSI Input Plan
  - Decision for written approval of SP trackside Assets specifications update (TACS/EULYNX B4R3)
  - Discussion about the approach to General Diagnosis Concept
  - Discussion about the response to CER/EIM paper on Railway System architecture
  - Debrief on ERA ERTMS Conference
- SP STG Meeting 10
  - Decision on written approval of Annual Work Plan 2025
  - Decision on written approval of CCS/TMS Data Model
  - Approval of general diagnosis concept and configuration management
  - Information about SP framework contract update: Lot 2 and Lot 3 status
  - Discussion about response to CER/EIM paper on Railway System architecture
  - Information about Energy report
  - Information about Traffic CS: Status in SC 2.3, System Concept review, Outlook on next year contract
  - Information about Train CS: Status & CCS Onboard architecture
- SP STG Meeting 11:
  - Year 2 summary

- Information about Standardisation and TSI Input Plan revision
- Information about System Concept – Traffic CS
- Information about Task 2 Operational domain update (Harmonisation Alignments)
- Information about Task 2 Architecture update: Change request pre-assessment bundles, High Level CCS logical architecture
- Information about Task 2 Computing Environment update: System Concept including Operational Analysis
- Information about Migration & Roadmap update: Migration Requirements for the Target System
- Information about Task 3 CMS/TMS update: CMS/TMS System architecture description
- Information about PRAMS: ERJU Hazard Database and NB rail involvement
- Information about EGNOS – Sector review

3.10. European Union Agency for Railways (ERA)

The SBA for EU-Rail, provide for a collaboration between the JU and ERA. In this respect, the rules of procedures of all relevant groups/bodies established under the JU foresee the participation of representatives from ERA (either as observers or their direct members). This ensures that the Agency is duly prepared to take into account the results of the Programme in its activities.

As a result, staff members of ERA have been participating in meetings of the JU's GB, SRG, SP-STG, Scientific Steering Board, High Level Deployment Group and DAC SB. Due to participation in the work of these bodies, the representatives of ERA had access and contributed to the draft documents in preparatory work for establishment of the Europe's Rail Joint Undertaking. Additionally, ERA is member of the System Pillar Core Group.

The JU's Governance and Process Handbook[57] clarifies the way ERA can access the R&I activities performed within the EU-Rail Programme in the areas of their competence, interoperability and safety.

In terms of contribution to the development of Technical Specifications for Interoperability (TSIs), the System Pillar has coordinated the input from the whole EU-Rail programme into the EU-Rail Standardisation and TSI Input Plan (STIP), which sets out the expected outputs from the EU-Rail programme into different harmonisation channels including TSIs. The first version of the STIP was approved by the SP-STG (including ERA and the EC) and published in July 2024. Additionally, the System Pillar supports the maintenance of the CCS TSI, including the update for the FRMCS specifications.

Regular coordination meetings have been organised between the two EDs, operational staff and communication staff. At a working level there is a close working relationship with ERA being involved where necessary in programme review and assessment, including Flagship Project maturity checkpoints. The overall objective is to ensure that the R&I innovative solutions that will be delivered by the EU-Rail Programme will be considered in the pipeline of ERA activities to avoid any step back in the future market uptake.

4. FINANCIAL MANAGEMENT AND INTERNAL CONTROL

4.1. Control Results

4.1.1. Effectiveness of Controls

4.1.1.1. Legality and regularity of the financial transactions

EU-Rail uses internal control processes to ensure sound management of risks relating to the legality and regularity of the underlying transactions for which it is responsible for, taking into account the multiannual character of programmes and the nature of the payments concerned.

The current JU Financial Rules were adopted on 20 December 2019 by its Governing Board (Decision N°11/2019) and entered into force on 1 January 2020. By means of these amended Financial Rules, the framework for the JU's financial procedures reflected the applicable version of the General EU Financial Regulation 2018/1046 which entered into force on 18 July 2018. As per this legal framework, the JU's financial procedures are designed in a manner allowing compliance with the principle of sound financial management.

As it was under the S2R JU, with EU-Rail becoming operational as of 30 November 2021, the JU continued to comply with the provisions of the applicable Model Financial Regulation. Any future departure from this Model Financial Regulation, as potentially required for the purpose of the Joint Undertaking's specific needs, shall be subject to the Commission's prior consent.

With regard to ICT tools applied to support its financial procedures, since 2016, the JU has utilized ABAC Workflow (accounting system of the European Commission). During the past years, the processes have been further reinforced with the introduction of the JU Cooperation Tool (including for in-kind contribution declarations and certifications) and the implementation of ICT tool ABAC Assets.

At the time of deployment of ABAC Workflow as mentioned above, the JU adopted its Manual of Financial Procedures[58] including the applicable Financial Circuits. This Manual of Financial Procedures was lastly revised in January 2024. It has been designed to guarantee a segregation of duties and to apply the four eyes principle in JU's financial transactions. In this respect, the initiation of a financial transaction and its verification are performed by different actors (ABAC users). Furthermore, the document describes in detail the financial circuits the JU implements per type of transactions and the roles and responsibilities of each actor involved in the implementation of its budget. To a lesser extent, it also describes the basic principles of main procedures (grants & procurements).

As for the JU budget, it comprises in principle two main types of expenditure:

- Administrative Expenditure covering both Titles 1 and 2 of the Budget, and
- Operational Expenditure covering Title 3 (for the S2R Programme) and Title 4 (for the EU-Rail Programme) of the Budget.

The Title 5 is dedicated to account for unused appropriations.

Due to their nature and the difference in ICT tools implemented at the JU to manage them, the financial circuits for these two expenditure types are different.

It should be noted that in addition to the JU-specific methodological framework for financial procedures, common rules of the R&I Family (Vademecum) established for Horizon 2020 and for Horizon Europe are applied by EU-Rail as well.

With regard to the accounting services, a significant change took place in 2022. In particular, with the exception of the treasury function, the Accounting Officer of the Commission ceased their services for EU-Rail and these were taken over by the JU's newly appointed Accounting Officer within the framework of the common back office arrangements (BOA) established among the Joint Undertakings. Moreover, in line with the provisions of the respective Service Level Agreement, EU-Rail took the role of the lead JU for the accounting part of the BOA and started acting as one of the three accounting service providers

[58] https://rail-research.europa.eu/wp-content/uploads/2024/01/EURAIL_ManualofFinancialprocedures_v2.1_clean.pdf

(complemented in this role by CA JU and SESAR JU) under the SLA. More information about synergies among JUs can be found in the section 2.7.2 "Efficiency gains and synergies" of the present document.

Ex-ante Controls on operational Expenditure

In 2024, the JU continued to follow the procedures for ex-ante controls defined internally (JU Financial Rules[59]) as well as the common Horizon 2020 / Horizon Europe ex-ante control framework.

EU-Rail has followed the Article 21(1) of its Financial Rules providing that "*each operation shall be subject at least to an ex-ante control relating to the operational and financial aspects of the operation, on the basis of a multiannual control strategy which takes risk into account*". The ex-ante controls are considered essential to prevent errors and to avoid the need for ex-post corrective actions. They take the form of checking contracts and grant agreements, initiating, checking and verifying invoices and cost claims and carrying out desk reviews (such as mid-term reviews carried out by external experts on JU's projects and other).

The JU applied standard financial circuits in ABAC Workflow for the commitments and payments. The circuit has a three-step authorisation performed by the following financial actors:

- Initiating Agent (OIA and FIA)
- Verifying Agent (OVA and FVA) and
- Authorising Officer (AO).

Staff members designated by the AO to verify financial operations are chosen on the grounds of their knowledge, skills, and appropriate professional experience.

The JU financial circuits comply with the requirements of the four eyes principle, segregation of duties and the independence of the verifier. At the same time, they allow also for the necessary flexibility to ensure the continuity of operations within the existing staff number limitations. The AO is the new Executive Director of EU-Rail, Mr Giorgio Travaini, who will act in accordance with EU-Rail's financial rules and has the final responsibility for any action or transaction carried out. Nevertheless, the AO can delegate all or part of his authorising authority for financial commitments or payments according to the delegation model adopted. This is reflected in the financial circuits by means of amendment to the JU's Manual of Financial Procedures introduced in January 2024.

For the operational expenditure, the JU recognises two different types of transactions: the ones solely performed in the ABAC Workflow and the ones with the initiation and verification functions outside of the ABAC environment - in the SyGMa tool. This tool is also linked to ABAC which allows real time controls over the budget and its implementation.

The particular system where the initiation and verification are to be performed is derived from the nature of the transaction, as follows:

- ABAC for all procurement related transactions, and
- SyGMa for any transactions related to grant management.

However, in all transactions, irrespective of whether initiated in SyGMa or ABAC, the AO will always give his/her authorisation in ABAC only.

A key element of the ex-ante controls is the "*Guidance Horizon 2020 ex-ante controls on interim & final payments*" adopted by the CSC Steering Board on 15 Dec 2016 and applicable as such to the JU. As a consequence of the approach introduced in this guidance, simplified ex-ante controls are applied. In particular, the level of details asked from the beneficiaries to be provided in each periodic report is limited, allowing the JU to check a limited number of conditions regarding the eligibility of costs. Ex-ante controls in Horizon 2020 are therefore trust-based, focusing on whether:

- the work has been done (as described in the periodic reports),

[59] https://rail-research.europa.eu/wp-content/uploads/2020/01/S2R-JU-Financial-Rules.pdf

- the reported effort and use of resources are reasonable and in accordance with the plan,
- sufficient explanation and justification are provided for any substantial deviations.

In practice, the assessment involves comparing the Description of the Action (DoA) and the budget earmarked with the work actually carried out, as per explanation provided in the periodic report, and with the costs being claimed by the beneficiaries in connection with it.

Certain elements (such as risk factors or deviations) are scrutinized to a lower extent when checking interim periodic reports when compared to assessing final reports. Moreover, since Certificate on the Financial Statements (CFS) are required only as part of the final reports, ex-ante controls in final periods are more in-depth. In addition, officers may take a more flexible approach to ex-ante controls in interim periods by asking beneficiaries for additional clarification in the ensuing reporting period. However, by the time the final payment is made, all outstanding issues should have been dealt with.

EU-Rail also applies for the actions falling under its current Programme the common guidelines for Horizon Europe, such as the "*HE Ex ante controls*" or "*HE Ex ante anti-fraud checks*" guidelines.. The HE ex ante controls developed in these guidelines build upon the principles and practices adopted under H2020 with enhancements based on lessons learnt. It combines a pre-defined set of simple and straight-forward standard controls with additional risk-based checks that are triggered when specific risks are detected. The main principles of the common HE ex ante control strategy are:

- Controls must provide reasonable assurance about legality and regularity, based on the information available at the time;
- Controls must strike the right balance between reducing the administrative burden and exercising effective financial control;
- Controls must be risk-based and cost-effective;
- Beneficiaries should be treated equally.

To complement the common HE guidance documents put in place by the European Commission, EU-Rail adopted end of 2023 its own HE Control Strategy for Grants[60], where especially the additional control practices performed by the JU on top of the standard level of checks are described (e.g. the maturity checkpoints). This Strategy is built on a risk-based approach and reflects the fact that EU-Rail applies solely the lump sum form of grants under its current programme.

Ex-post controls of operational expenditure and error rates identified

Ex-post controls are defined as the controls executed to verify the financial and operational aspects of finalised budgetary transactions in accordance with Article 22 of the JU Financial Rules. The main objectives of the ex-post controls are to ensure that the principles of legality, regularity, and sound financial management (economy, efficiency and effectiveness) have been respected and to provide the basis for corrective and recovery activities, if necessary. These controls are the last stage of the JU's control strategy in the project life cycle.

For the **HE programme**, under the lump sum funding, EU-Rail payments will not depend on the costs actually incurred by the beneficiaries. Beneficiaries will not have obligation vis-à-vis the JU to document and report costs incurred in the course of action implementation. The checks, reviews and audits will focus on the fulfilment of the conditions for releasing lump sum contributions per work package, and on compliance with other obligations embedded in the grant agreement, such as for example in the area of ethics and research integrity, dissemination and exploitation of results, management of intellectual property, etc. There will be no financial ex-post audits conducted by the Common Audit Service ("the CAS") of DG Research and Innovation (RTD) for EU-Rail lump sum grants. However, EU-Rail intends to perform for its lump sum grants ex-post reviews of qualitative (technical) nature with deployment of external experts as described in its HE Control Strategy for Grants adopted end of 2023, and as tested by means of a pilot review conducted in June 2023. By these ex-post reviews, which will represent a supplementary control layer to the ex-ante control activities, instead of dealing with eligibility of individual cost items incurred during the life of the project and detection of errors pertaining thereto, emphasis will be put on scientific/technical

[60] EU-Rail HE Control Strategy revised in December 2024 and adapted with the new guidance from RTD on ex-post technical reviews for lump sum grants.

performance and output of projects. Hence the overall JU's control approach for grants under Horizon Europe is characterized by shifting from quantitative (financial) type of controls to qualitative (technical) type of controls. On the other hand, EU-Rail foresees that the implementation of its own ex-post reviews of lump sum grants will be complemented by the assurance, especially in the form of audits, provided by the dedicated EU audit bodies, most notably by the European Court of Auditors and by the Internal Audit Service of the Commission, the latter acting as internal auditors of EU-Rail. Such independent audit activities of those bodies would be based, in line with their mandates, on their own methodology as applicable to the lump sum form of funding.

For the **H2020 programme**, the ex-post controls include the financial ex-post audits as well as the recovery/correction of any amounts found to have been paid in excess of the sum eligible.

Ex-post controls of operational expenditure at EU-Rail are covered by the Horizon 2020 Audit Strategy. The implementation of the Horizon 2020 Audit Strategy falls under the responsibility of the CAS. The role of the CAS is defined in the Commission Decision "C(2014) 2656 final" on the operating rules for the Common Support Centre for Horizon 2020, the Framework Programme for Research and Innovation (2014-2020)[61]. As follows from this Decision "*The Common audit service shall contribute to assessing the legality and regularity of Horizon 2020 project payments by means of ex-post financial controls carried out, either by its own auditors or by independent audit firms in accordance with the decisions of the Steering Board. It shall provide the relevant Authorising Officers by Delegation (AODs) with necessary elements of assurance on the research budget for which they are responsible.*"[62]

The main actions identified to realise the objectives following from the Horizon 2020 Audit Strategy include:

- the gradual achievement, in a cost-effective way, of quantitative multi-annual targets in terms of audited participations[63];
- the closure and communication of audit findings and extension of audit findings to those responsible for their implementation providing the basis for corrective and recovery activities, if necessary.

For Horizon 2020, the CAS carries out all audits, including those concerning grants concluded by the Executive Agencies and the Joint Undertakings. This is a major step towards ensuring efficiency gains, a harmonised approach, legal certainty, equality in treatment of beneficiaries and the least audit burden on beneficiaries.

The main indicators on legality and regularity of EU Framework Programmes for Research and Innovation are:

- **Cumulative representative detected error rate**, based on errors detected by ex-post audits on a Common Representative Sample of cost claims across the R&I Family.
- **Cumulative residual error rate**, which is the extrapolated level of error after corrective measures have been implemented by the respective services following the audits, accumulated on a multi-annual basis.

The **targets** set at the R&I Family level for this control system are, respectively:

- For Horizon 2020, to ensure that the cumulative residual error rate remains within a range of 2-5 %, aiming to be as close as possible to 2%. Progress against Horizon 2020 targets is assessed annually based on the results of the implementation of the ex-post audit strategy and taking into account the frequency and importance of the detected errors along with cost-benefit considerations regarding the effort and resources needed to detect and correct the errors.
- For Horizon Europe, to ensure that cumulative detected and residual error rates do not exceed 2%[64].

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61 https://ec.europa.eu/transparency/documents-register/detail?ref=C(2014)2656&lang=en

62 In principle, the same mandate of the CAS applies also for the Horizon Europe Framework Programme as defined in Article 23 of the Commission Decision C(2021) 4472 final.

63 A participation is the combination of a beneficiary and an action. An audit can cover more than one participation.

64 No representative error rate for Horizon Europe is yet available in 2024. Originally planned in 2023, the HE ex-post audits selected in 2024 will only be closed in 2025.

It should be noted, however, that due to its multi-annual nature, the effectiveness of the ex-post control strategy of the R&I Family can only be measured and assessed fully in the final stages of the EU Framework Programme, once the ex-post audit strategy has been fully implemented, and errors, including those of a systemic nature, have been detected and corrected.

The Horizon Europe Audit Strategy of the R&I Family is risk-based and draws on the achievements of lessons learnt from Horizon 2020.

However, as EU-Rail will continue to applying exclusively lump sum form of grants under the Horizon Europe Programme, and since such grants cannot in principle be subject to financial type of ex-post audits conducted by the CAS, the JU has updated its HE Control Strategy for grants for conducting its own ex-post technical reviews focused more on the qualitative (technical) aspects of implementation of lump sum grants. First pilot of such an ex-post review of the respective lump sum participation was carried out by EU-Rail in June 2023 in order to assess in the work performed by one of the beneficiaries of a lump sum project and provide another layer of assurance. Overall conclusion was positive and in line with the objective and scopes of action under the Grant Agreement. EU-RAIL in accordance with its HE Control Strategy for grants has launched two ex-post technical reviews in 2024 upon request from the CAS.

Ex-post controls of the Horizon 2020 programme globally

In 2020, the Commission refined its methodology for calculating the Horizon 2020 error rates in line with the European Court of Auditors' observations in its 2018 and 2019 Annual Reports. The IAS has carried out a limited review on the methodology for calculation of the error rates of Horizon 2020 in the year 2020. The findings of this limited review confirmed that there is no weakness in the calculation of the detected error rate and that the impact of these findings on the accuracy of the calculation of the residual error rate is minor. The three recommendations issued were closed by IAS with the Note on audit conclusions [65]in March 2024.

The error rates for Horizon 2020[66] globally as of 31 December 2024 were the following:

- Cumulative representative detected error rate: 3,55%[67],
- Cumulative residual error rate for the for the Framework Programme: 1,79% (1,99% for DG Research and Innovation[68]).

These error rates are calculated on the basis of the audit results available when drafting the Consolidated Annual Activity Report. They should be treated with caution as they may change subject to the availability of additional data from audit results.

Since R&I Framework Programmes are multi-annual, the error rates, and the residual error rate in particular, should be considered within a time perspective. Specifically, the implementation of the audit results over time will tend to lower the cumulative residual error rate thus increasing its difference with the representative detected error rate.

Given the results of the audit campaign, and the observations made by the European Court of Auditors in its Annual Reports, the Common Implementation Centre of DG Research and Innovation, in close cooperation with central Commission services, defined actions aimed at significantly simplifying the rules and paving the way for an important reduction of the error rate in Horizon Europe. Actions were undertaken including further simplification, increased use of simplified forms of funding (including lump sums and unit costs), focused communication campaigns to more "error-prone" types of beneficiaries with higher-than-average error rates (such as SMEs and newcomers), and enhanced training to external audit firms performing audits on behalf of the Commission. Focusing on the most common errors, these actions will be straightforward and achieve higher impact.

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65 Note on audit conclusions by Internal Audit Service (IAS): Ref. ARES(2024)1956231 – 14/03/2024

66 The Horizon 2020 audit campaign started in 2016. At this stage, six Common Representative Samples with a total of 944 expected results have been selected. By the end of 2024, cost claims amounting to EUR 56.7 billion have been submitted by the beneficiaries to the services. The audit coverage for Horizon 2020 is presented in Annex 7. In addition to the Common Representative Samples, Common Risk Samples and Additional Samples have also been selected. The audits of 5.247 participations were finalised by 31/12/2024 (of which 540 in 2024).

67 Based on the 765 representative results out of the 944 expected in the six Common Representative Samples.

68 It should be noted that most of Horizon 2020 grants managed by DG Research and Innovation were delegated to Executive Agencies. Hence, this figure is based only on the actions that remained with the DG R&I.

Horizon Europe Framework Programme

2024 was the third year of implementation of the Horizon Europe Framework Programme. No representative error rate for Horizon Europe is available in 2024 as the ex-post audit campaign for the Programme is planned to be launched in 2024 and closed in 2025, once a meaningful number of payments is available for audit.

Ex-post controls 2024: EU-Rail specific sample

The number of ex-post audits of EU-Rail participations carried out by the CAS until year end 2024 corresponds to the relatively small share of the JU's budget (less than 1%) in relation to the overall H2020 budget. However, the JU in cooperation with the CAS continuously strive for ensuring on an ongoing basis sufficient ex-post audit coverage allowing to provide the respective reasonable assurance to the EU-Rail Executive Director to support his declaration of assurance, also in light of the discharge procedure.

The previous years of the H2020 audit campaign were still marked for the CAS with the effects of the Covid-19 pandemic, which adversely influenced the execution of the ex-post audits in 2020 and 2021, and created a backlog reflected in the reduced number of new sample selections for the 2022 target (9 participations in the case of EU-Rail). The EU-Rail sample counting towards its 2023 local representative audit target counted 5 participations and no new participations for the current year foreseen for EU-Rail. However, as previously mentioned, there is a backlog at CAS's side related to previously selected participations leading to at least 2 audits of participations to be carried over to 2025.

The CAS managed to close 6 ex-post audits of EU-Rail participations in 2024.

In Q2 2024, the CAS confirmed the selection of the EU-Rail participations counting towards its 2025 local audit target, with no additional selections concerning the old S2R programme.

As of 31 December 2024, total cumulative cost claims related to projects managed by EU-Rail, hence representing its potentially auditable population, reached the amount of EUR 366.837.804,73 for 101 projects. As for the amount of cost claims audited by the end of 2024, it was EUR 19.667.967,67 representing the direct EU-Rail audit coverage of 5,36%. The indirect coverage, i.e. the total directly non-audited cost claims of all audited EU-Rail beneficiaries amounted to EUR 267.166.173,45(72,83%).

The overall status for H2020 ex-post audits related to the JU projects as of yearend 2024 is shown below[69].

Number of participations for which audits were launched during individual years (risk-based audits not included):

GROUP	Total Launch 2017	Total Launch 2018	Total Launch 2019	Total Launch 2020	Total Launch 2021	Total Launch 2022	Total Launch 2023	Total Launch 2024	Launch Total	Total Closed 2018	Total Closed 2019	Total Closed 2020	Total Closed 2021	Total Closed 2022	Total Closed 2023	Total Closed 2024	Closed Total	Sched Total	Open Total	Sched + Open + Closed Total
EU-RAIL	16	17	12	39	12	5	5	1	107	4	22	22	30	12	11	6	107	2	0	109

H2020 - CAS - PARTICIPATIONS CLOSED PER CLIENT - OVERALL VIEW - TOP-UPS INCLUDED

Framework	Domain	Client	Closed 2016	Closed 2017	Closed 2018	Closed 2019	Closed 2020	Closed 2021	Closed 2022	Closed 2023	Closed 2024	Closed Total
H2020	CAS	EU-RAIL	0	0	4	22	22	30	12	11	6	107

Overview of cost claim figures related to the JU projects as of 31/12/2024:

Total number of validated cost claims	3124
Total cost accepted by JU (cumulative) (A)	366.837.804,73
Total cost audited by the end of 2023 (B)	19.667.967,67
Total non-directly audited cost claimed by audited JU's beneficiaries (C)	267.166.173,45

[69] As per the data files provided by the CAS.

Direct audit coverage ratio (B / A)	5,36%
In-direct audit coverage ratio (C / A)	72,83%

As of 31 December 2024, 93 final audit reports from ended ex-post audits covering the JU's projects were available.

Overall detected error rate based on 109 participations: by applying simple average is 2,29% and by applying weighted average is 1,88%.

Representative Error Rate based on 103 participations: by applying simple average is 2,35% and by applying weighted average 1,93%.

EU-Rail Residual Error Rate: by applying simple average is 1,01% and by applying weighted average 0,67%.

As at the cut-off date 31.12.2024, **the JU's H2020 cumulative residual error rate is below the targeted threshold of 2%**[70] under both methodologies - the simple and the weighted average.

4.1.1.2. Fraud prevention, detection, and correction

Early July 2022, EU-Rail adopted its new Anti-Fraud Strategy for 2022-2025[71] which replaced the previous one initially introduced in 2017. The adoption was preceded by a thorough specific fraud risk assessment. Part of this assessment, in particular the one pertaining to the fraud risks in grant management, was conducted commonly at the level of the entire Family of the EU Research & Innovation Services, Agencies and Joint Undertakings (Research Family) and steered by DG RTD. This was complemented at EU-Rail level with the assessment of other risks of fraud, such as those related to procurement, recruitment, misuse of internal information, misuse of JU's reimbursement schemes, etc.

EU-Rail also actively participated in the activities of the Fraud and Irregularities in Research (FAIR) Committee included the preparation of the new Common Anti-Fraud Strategy in the Research and Innovation Family (RAFS). The document was finally adopted in January 2024[72].

By means of its current own Anti-Fraud Strategy, similarly to the previous one, EU-Rail continues to cover, to the applicable extent, all four elements of the anti-fraud cycle, namely: prevention, detection, support to investigation and correction.

The main anti-fraud objectives of the JU for the period of 2022-2025 are the following:

1) keeping the JU's internal legal framework related to anti-fraud policy up to date,
2) fostering an anti-fraud culture throughout the organisation,
3) maintaining a high level of awareness and knowledge among the staff members on the subject matter,
4) ensuring high level of reactivity towards OLAF/EPPO,
5) preventing the misuse of internal information/data.

These objectives are pursued by means of particular measures and actions, as listed in the below action plan. The actions are subject to follow-up and to assessments regarding potential updates conducted, as a minimum, once a year. For 2024, the follow-up of the anti-fraud actions brought the following outcomes:

[70] See Annex I for materiality criteria regarding the error rate.
[71] https://rail-research.europa.eu/wp-content/uploads/2022/07/ED-DECISION_ED-22-02_Anti-Fraud-Strategy-2022-2025_Annex_AFS.pdf
[72] Common Anti-Fraud Strategy in the RAFS: Ref. ARES(2024)685584 – 30/01/2024

	Action	Follow-up on the action plan for 2024
1	The EU-Rail management strives for ensuring the appropriate overall anti-fraud culture throughout the organisation and sets the tone at the top by conveying messages to staff on the subject matter stressing the importance of acting according to the highest professional and ethical standards.	2 communications related to fraud prevention and ethics were provided to EU-Rail staff from the Executive Director
2	The EU-Rail bodies are informed about the JU's anti-fraud policy and its practical application and their members are reminded of their duties related to the subject matter, most importantly on the obligation of reporting any conflicts of interests.	Information on the anti-fraud policy implementation as part of the internal control framework assessment outcomes was provided in the EU-Rail GB meeting held on 09/04/2024 and later on 14/06/2024 in which also the 2023 CAAR was adopted, containing information on the EU-Rail anti-fraud policy. Other written communications were provided to the EU-Rail GB members and observers, including reminders on submitting declarations of interests.
3	The EU-Rail internal legal framework related to the anti-fraud matters is regularly reviewed in order to keep it up to date and complete.	A review was performed via EU survey questionnaire. The JU aims to implement by 2025 the new common level EC regulation[73] on cybersecurity for Union entities with regard to the establishment of an internal cybersecurity risk management, governance and control framework.
4	The EU-Rail staff members are regularly provided with information and updates with regard to anti-fraud matters by means of a dedicated section on the JU's intranet.	A dedicated intranet page and a comprehensive repository of files related to anti-fraud matters and ethics was maintained and made available to staff.
5	Regular information sessions and trainings are organised for EU-Rail staff on the subjects of anti-fraud and ethics.	Two dedicated anti-fraud training sessions were made available to EU-Rail staff. Specific communications were made to EU-Rail staff on ethics-related matters, especially with regard to declarations of interest. Several awareness-raising communications were made to EU-Rail staff with regard to cybersecurity and IT threats, and a phishing test campaign was participated to by the JU.

[73] Regulation (EU) 2023/2841 laying down measures for a high common level of cybersecurity at the institutions, bodies, offices and agencies of the Union

	Action	Follow-up on the action plan for 2024
6	Ensure comprehensive and timely cooperation with the respective EU bodies (OLAF, EPPO) and swift provision of requested information and documents in cases of investigations or other activities with regard to potential fraud.	No case occurred at EU-Rail requiring reporting to OLAF/EPPO. EU-Rail provided comments to OLAF within the update of the Methodology and Guidance for the Drafting of an Anti-Fraud Strategy by Decentralised Agencies and Joint Undertakings in 2023 and the final OLAF AFS Methodology was made available in May 2024.
7	Ensure appropriate follow-up and the necessary action based on the results of OLAF's/EPPO's investigations and other activities by means of recovery of the concerned amount of funds, application of administrative sanctions and other measures.	No case investigated by OLAF/EPPO occurred requiring follow-up actions by EU-Rail.
8	Participate in the Research Family anti-fraud activities by contributing to common discussions, outputs and documents. Utilising of the knowledge shared within the Research Family in JU's internal anti-fraud documents, activities and trainings.	EU-Rail participated in the FAIR Committee meetings held in 2024 and actively contributed to the common R&I Family activities, such as the 2024 revision of the rules of procedure of FAIR committee and the preparation of the 2023 RAFS update, which was endorsed in January 2024.
9	Ensure an appropriate level of cooperation with the parent Commission Service – DG MOVE.	EU-Rail proactively provided to DG MOVE updated information on the developments regarding the anti-fraud matters as part of the Antifraud Strategy of DG MOVE 2021-2027. EU-Rail representatives actively participated in a DG MOVE/DG ENER SRD workshop on cybersecurity.

In accordance with the current EU-Rail Anti-Fraud Strategy, and in line with agreement on usage of common indicators within the Research Family, the below indicators with regard to the results of fraud prevention/detection/correction activities are reported as at year end 2024:

	Indicator	Result for 2023
1	Number of messages/communications on anti-fraud matters addressed to the staff by the Executive Director.	2 communications related to fraud prevention and ethics were provided to EU-Rail staff from the Executive Director
2	Number of information on anti-fraud matters communicated to the EU-Rail Governing Board and other JU bodies, as applicable.	1 dedicated presentation in the EU-Rail GB meeting. 1 written communication to the EU-Rail GB members and observers.

	Indicator	Result for 2023
3	Number and value of contracts subject to close monitoring or additional controls due to an assessment of a high risk of fraud.	0
4	New cases sent to OLAF and opened in the respective year, and cases handled by OLAF relevant to EU-Rail in that year.	0
5	Timeliness and completeness of JU's implementation of financial recommendations received from OLAF.	No recommendations were received from OLAF.
6	Time elapsed between OLAF requests for information and date when the information is provided to OLAF.	No requests for information were received from OLAF.
7	Number and content of performed trainings and other activities aimed at awareness-raising of the EU-Rail staff.	2 anti-fraud trainings were made available to EU-Rail staff. 2 communications were made to EU-Rail staff on ethics-related matters, especially with regard to declarations of interest. 3 anti-fraud awareness sessions with regard to anti-fraud, cybersecurity and IT threats.
8	Number of cooperative activities in the field of anti-fraud policy with relevant stakeholders (e.g. FAIR Committee, other JUs) to which representatives of EU-Rail participated and contributed to.	EU-Rail participated in the FAIR Committee meetings held in 2024. EU-Rail actively contributed to the preparation of the 2023 RAFS update, which was finally endorsed in January 2024. The JU proactively provided to DG MOVE updated information on the developments regarding the anti-fraud matters. EU-Rail representatives actively participated in a DG MOVE/DG ENER SRD workshop on cybersecurity

4.1.1.3. Assets and information, reliability of reporting

EU-Rail continued in 2024 to apply various measures and control activities in order to safeguard its assets and information.

In that respect and to protect EU public funds from potential irregular or illegal application, EU-Rail thoroughly applies within the grant and procurement management all the requirements regarding controls and checks following from the applicable legal framework as well as from the common methodological

guidance provided by the Commission. These are complemented, where deemed necessary, by additional internal guidelines and manuals application of which is then reflected in the day-to-day conduct of control activities at the JU. Apart from various ex-ante and ex-post controls, continuous monitoring is ensured with regard to the implementation of the JU's budget, to operational and administrative payments and to the JU Members' reporting of their in-kind contributions/total project costs. Follow-up is conducted with particular beneficiaries to JU's grants, if the financial ex-post audits performed by the CAS reveal systemic or recurrent errors indicating deficiencies in beneficiaries' control systems.

In addition to the safeguards aimed at financial aspects, EU-Rail pays attention also to non-financial elements of its assets and information. Due care is taken with regard to personal data protection, to which all Joint Undertakings (JUs) located in the White Atrium building in Brussels adhere to. For example, a comprehensive Data Protection Impact Assessment was carried out in 2021 in connection with the Microsoft Office Online services implementation, results of which were properly documented. Measures are applied for the deployed IT tools and IT infrastructure so that information processed electronically is adequately protected from theft or loss. Similarly, measures for physical protection of assets, documents and data contained therein are in place at the EU-Rail premises. Awareness-raising activities are held regularly for the benefit of the JU's staff to draw their attention to the importance of protection of assets and information, especially with regard to phishing, being still the most common way how intruders from the external environment seek their way to gain unauthorised access to non-public data. A comprehensive Document Management Policy[74] is applied at the JU which is formalised by means of the respective ED Decision.

In 2024, the JU continued to implement the EU data protection policies and legal framework. As regards the processing of personal data, the JU applied the current EU Data Protection rules (Regulation (EU) 2018/1725 or "EUDPR"[75]) that entered into force on 11 December 2018. In particular, the JU Data Protection Officer (DPO) followed the recommendations and guidance provided by the European Data Protection Supervisor (EDPS), attended the different data protection meetings and networks, coordinated his work with the other DPOs and provided guidance to JU staff on data protection issues.

To ensure compliance with the data protection principles and synergies with the other Joint Undertakings, EU-Rail took the following actions:

- continued the monitoring of a common inter-JU central on-line register of records of activities processing personal data (article 31(5) Regulation (EU) 201 8/1725) tailor-made to the needs of the JUs;
- In accordance with article 43(4) of Regulation 2018/1725, EU-Rail externalised the DPO function to an external provider via a procurement contract, which is allowed for small or medium sized EU agencies and bodies – article 43(2) of the Regulation besides sharing the same DPO tasks amongst several JUs in line with the synergies of the back-office arrangements in the legal field (article 13 of the SBA).
- Continued to reply to the EDPS requests, such as a survey ("questionnaire)" on the designation and position of the Data Protection Officer
- continued to update privacy policies and the central data protection register (https://rail-research.europa.eu/dpregister/) in order to provide transparent information, communication and modalities for the exercise of the rights of the data subjects (Articles 14 to 16 of Regulation (EU) 2018/1725).

In 2024, with the support of the external contractor Privanot under the EU-Rail framework contract for legal assistance, DPO finally implemented the EU-Rail data protection gap analysis and the Data Protection Plan based on the objectives used by the European Commission's in its own data protection action plan. The overall results were positive and some recommendation measures were provided.

In 2024, neither Data Protection Impact Assessment (article 39 EUDPR) were performed by EU-Rail, nor personal data breaches were reported and notified by the DPO to the EDPS.

[74] https://rail-research.europa.eu/wp-content/uploads/2022/12/EU-Rail_DMP_20221206_final_clean.pdf

As is described in more details in other parts of Chapter 4 of this CAAR, no material issues were detected in 2024 at EU-Rail in terms of inadequate safeguarding of assets or information neither in the audits conducted by the ECA/IAS, nor by the comprehensive self-assessment of the EU-Rail internal control system. No case of exception occurred in 2024, but two non-compliance events occurred in 2023 and were closed in 2024. The first concerning internal invoicing among JUs under an SLA occurred in September 2023. There was no financial impact and measures were taken to improve the control mechanisms such as updates in the respective internal written guidance and additional checks included in the monthly implementation review. The latter occurred in December 2023 concerns a FWC related to catering services under a BOA procurement, which was not in accordance with the terms and conditions of the FWC. There was financial impact and measures implemented to mitigate the risk associated and prevent it to happen in the future include signing a standard yearly order form based on FWC templates for procurement contracts and creating a monitoring table on consumption of the yearly order form as well as liaise with Clean Aviation JU (lead JU of the FWC) so EU-Rail limits payments on a monthly basis.

As in the previous year, the role of the DPO was exercised in 2024 by the JU's Chief Legal Officer. The current mandate of the DPO expired at the end of the year, but it was renewed for an additional term of 5 years since October 2024.

As for reliability of reporting, EU-Rail continuously strives for utilising precise and up-to-date information for reporting purposes, most notably for the production of its consolidated annual activity reports. In this respect, especially in the field of grant management, the IT tools and systems owned by the Commission, and deployed also by EU-Rail (Compass, SyGMa, Corda), are used as the primary source for collecting various sets of data. These are further complemented by internal tools, databases and repositories maintained by the respective staff members. Possibilities for improvements in internal data processing and record-keeping are considered on an ongoing basis. Attention is paid to maintaining audit trail so that the reported data can be traced back to its initial source, as necessary, mostly by means of registering files in Ares.

4.1.2. Efficiency of controls ('Time to')

Similarly to other EU services and bodies, EU-Rail, as follows from its Financial Rules, is subject to requirements pertaining to the efficiency of controls and checks applied in the grant agreement management and, as applicable, in management of other types of contracts and agreements. This means that the JU should on one hand ensure due diligence in performing the necessary checks ensuring the sound financial management, but at the same time, meet the set time limits for certain milestones in the preparation of, or during the lifetime of the grant/contract. Such time limits are referred to as:

- "time to inform" – i.e. the time elapsed from the submission of complete proposal to the moment of informing the applicant on the evaluation outcome (should not be longer than 6 months),
- "time to sign/grant" – i.e. the time elapsed from informing the successful applicant on the results of the call evaluation to the moment of signing of the grant agreement (should not be longer than 3 months),
- "time to pay" – representing different time limits for making the respective payment to the counterparty, being 90 calendar days maximum in case grants-related payments.

EU-Rail uses various monitoring tools in order to comply with the above-mentioned time limits.

The average values of the "time to" indicators applicable to all JU's grants are included in Annex E, Table I of this CAAR.

It can be concluded that despite the ad hoc accumulation of workload in certain periods of the year, the JU managed on average to meet the deadlines represented by the "time to" indicators. The results for 2024 have not changed significantly as compared to last year and remain within the target values.

4.1.3. Economy of controls

This section provides information about the JU's cost of the controls applied in connection with grant management and procurements[76].

JU's resources dedicated to ex-ante controls in connection to grants:

Stage of the control	Description	Year			
		2023		2024	
		EUR	EUR	EUR	FTE
Stage 1 – Programming, evaluation and selection	Cost of programming + evaluating + selecting / value contracted	95.900	1,1	117.200	1,3
Stage 2 – Contracting including financial (commitments, guarantees,…) and legal checks	Cost of controls related to the contracting / amount paid	42.800	0,5	43.400	0,5
Stage 3 – Monitoring the execution and ex-ante financial management	Cost of controls related to the monitoring of the execution / amount paid	320.200	3,9	324.600	4,1
Total ex-ante		458.800	5,5	485.900	5,8

JU's resources dedicated to ex-post controls in connection to grants:

Stage of the control	Description	Year			
		2023		2024	
		EUR	FTE	EUR	FTE
Stage 4 – Ex-post controls and recoveries	Total cost related to ex-post audits / grants audited	45.500	0,5	60.700	0,7
Total ex-post		45.500	0,5	60.700	0,7

JU's resources dedicated to ex-ante controls in connection to procurements:

Stage of the control	Year			
	2023		2024	
	EUR	FTE	EUR	FTE
Stage 1 – Planning the procurement procedures, including legal checks	68.800	0,7	69.000	0,8

[76] The information presented in this CAAR Section corresponds with data reported to DG MOVE with respect to cost of control.

Stage 2 – Contracting, including financial (commitments, guarantees,…) and legal checks	65.600	0,8	59.900	0,8
Stage 3 – Monitoring the execution and Financial operations (ex-ante), controls on the acceptance of goods and services	90.000	1	91.700	1,1
Total ex-ante	224.400	2,5	220.700	2,7

JU's resources dedicated to ex-post controls in connection to procurements:

Stage of the control	Year			
	2023		2024	
	EUR	FTE	EUR	FTE
Stage 4 – Supervisory checks (ex-post), audit, ex-post technical controls if relevant	11.200	0,1	9.100	0,1
Total ex-post	11.200	0,1	9.100	0,1

The internal JU's overall cost of controls (both ex-ante and ex-post) related to grants then represented approximately 0,7% of the EU-Rail operational expenditure/total expenditure in 2024.

The internal JU's overall cost of controls (both ex-ante and ex-post) related to procurements represented approximately 0,3% of the EU-Rail operational/total expenditure in 2024.

The ratios of combined internal cost related to both grants and procurements to the overall 2023 JU's costs are included in the following table:

JU expenditure in 2024 in EUR millions		Estimated overall costs of **ex-ante** controls in 2024 in EUR	Overall costs of **ex-ante** controls in relation to expenditures in %
Operational	72,9	706.600	0.96%
Total	78,1		0,90%
JU expenditure in 2024 in EUR millions		Estimated overall costs of **ex-post** controls in 2024 in EUR	Overall costs of **ex-post** controls in relation to expenditures in %
Operational	72,9	69.300	0,0955%
Total	78,1		0,0889%

In terms of own human resources allocated in 2024 to controls related to grants and procurements, both ex-ante and ex-post, approximately 9,3 FTEs were involved. This represents about32,06,% of the total FTEs employed by the JU as at year end 2024.

4.1.4. Conclusion on the Cost-effectiveness of controls

The total estimated cost of controls (ex-ante + ex-post) related to grant management and procurement in 2024 represent approximately the amount of EUR 775,900 which represents an increase compared to the previous year.

There will be changes in the future on the deployment of controls, especially in the field of ex-post controls related to grants. With the application of lump sum form of grants, the focus of ex-post controls will no

longer be on verifying the costs actually incurred by the beneficiaries, but rather on technical aspects of the grant implementation. Since the JU will have to conduct/steer, using its own capacities, the qualitative (technical) ex-post reviews, apart from the expected qualitative changes in the internal deployment of capacities dedicated to grant-related controls, also quantitative changes can be expected in this respect in the future – towards the increase of the total capacities used for ex-post controls. The volume of control capacities dedicated to the procurement and contract management should remain at a similar level, reflecting the amount of JU's funds deployed through procurements.

With regard to cost-effectiveness of controls, the following table presents figures on overall cost spent at EU-Rail in 2024 on controls related to grants and procurements, compared to total cost[77]:

Cost of controls / Total expenditure 2024 (administrative + operational)	0.99%
Cost of controls / Operational expenditure 2024	1,06%

The increase compared to 2023 (0,24%) is attributable to the overall lower amount of expenditure, rather than to the actual changes in the volume of JU's control activities.

As for the benefits and particular financial effects of the controls carried out, in most of the cases, these are not possible to be effectively calculated in a precise manner. In general, the main benefit of controls resides in the continuous reasonable assurance on the fact that the principle of sound financial management is being pursued which includes preventing and detecting potential irregularities. To a limited extent[78], the recoveries following from the financial ex-post audits carried out by the CAS could be considered as a form of particular positive financial impact (benefit) resulting from controls. In this respect, Annex E, Table I of this CAAR provides the respective KPI on implementation of audit results.

In conclusion, from the JU's perspective, controls applied in grant management and procurement are considered cost-effective. Emphasis is given to adequate balance between low error rates and timely payments on one hand, and the costs dedicated to carrying out controls on the other hand. By deploying lump sum form of funding for the grants under its Programme, EU-Rail also strives for simplification for its beneficiaries by decreasing their administrative burden regarding reporting of costs during the lifetime of projects funded by the JU. In this connection, the fact that EU-Rail will need to steer the ex-post control activities related to lump sum grants by means of its internal capacities and will not be able to count on the CAS in that respect, could increase the JU's cost of controls in the future, having potentially implications on the overall cost-effectiveness of controls. Anyway, achieving reasonable assurance with regard to the sound financial management of the grant implementation will continue to be in focus of EU-Rail.

4.2. Audit observations and recommendations

4.2.1. Internal Audit

In accordance with Article 28 of the JU Financial Rules, the internal audit function shall be performed by the Commission's Internal Audit Service (IAS). IAS reports on its findings and recommendations to the Joint Undertaking's GB and ED.

The internal auditor shall advise the JU on dealing with risks, by issuing independent opinions on the quality of management and control systems, and by issuing recommendations for improving the implementation of operations and promoting sound financial management.

In line with the International Standards for the Professional Practice of Internal Auditing[79] IAS confirmed in January 2025 to the Chairperson of the EU-Rail GB and to the ED its organisational independence of their internal audit activity conducted in 2024, as well the fact that their work in 2024 was free from interference in determining the scope of internal auditing, performing work and communicating results. IAS also confirmed that in 2024, there was no impairment to individual objectivity, in particular through conflict of

[77] It should be noted that the quantification of JU's cost of controls is based to a certain extent on qualified estimates and simplified assumptions, as a more precise cost calculation would require continuous detailed time recording throughout the year of all particular control activities conducted at the level of all concerned staff members. Such recording would create excessive administrative burden and would not be considered feasible in terms of the cost-benefit ratio.

[78] The primary aim of the control system should be on prevention, that is to minimise as such the occurrence of errors in grants and the necessity of subsequent recoveries.

[79] As of 9 January 2024, the Standards maintained by the Institute of Internal Auditors are referred to as the "Global Internal Audit Standards".

interest, scope limitations, restrictions on access to records, personnel, and properties, or resource limitations.

Following its in-depth risk assessment performed at the JU during Q4 2023, IAS drew up their Strategic Internal Audit Plan for EU-Rail for 2024-2026[80]. The JU was notified in March 2024 by IAS that their engagement planned to start in 2024 and to be finalized in 2025 will be the audit on the set up of back office arrangements (BOA) between the joint undertakings.

Within the agreed timeline following from the action plan, EU-Rail provided to IAS the respective information and documents with regard to the remaining three outstanding recommendations that resulted from the "Audit on H2020 grant implementation and closing". In March 2024 IAS confirmed that the JU has adequately and effectively implemented those recommendations and that they were closed. Hence, there are currently no pending IAS audit recommendations.

4.2.2. Audit of the European Court of Auditors

The European Court of Auditors (ECA) with its mission of February 2025 completed its work which resulted in the JU's Annual Audit Report for the year 2023, in accordance with the ECA mandate as defined in the TFEU.

During 2024, for the 2023 Financial Year, the European Court of Auditors released the following opinions:

Opinion on the reliability of the accounts

"In our opinion, the accounts of the EU-Rail JU for the year ended 31 December 2023 present fairly, in all material respects, the financial position of the EU-Rail JU as at 31 December 2023, the results of its operations, its cash flows, and the changes in net assets for the year then ended, in accordance with its Financial Regulation and with accounting rules adopted by the Commission's accounting officer. These are based on internationally accepted accounting standards for the public sector."

Opinion on the legality and regularity of revenue underlying the accounts

"In our opinion, the revenue underlying the accounts of the EU Rail JU for the year ended 31 December 2023 is legal and regular in all material respects."

Opinion on the legality and regularity of payments underlying the accounts

"*In our opinion, payments underlying the accounts for the year ended 31 December 2023 are legal and regular in all material respects."*

The ECA reported no major or critical findings for the JU in its Annual report on EU Joint Undertakings for the financial year 2023. However, two observations were raised:

- The current business continuity plan (BCP) and related disaster recovery plan (DRP) do not reflect the significant changes to the JU's operating environment that have occurred since 2020. In order to mitigate the related operational risks, such as incomplete or delayed recovery of operational data in case of a disaster, the common BCP and DRP should be updated and their effectiveness tested.
- For Horizon 2020 activities, the JU received no new operational commitment appropriations, as the JU had finished its last call for proposals by the end of 2021. The implementation rate for the operational payment appropriations, including operational unused and reallocated appropriations, fell to 47 % (2021: 61 %). According to the JU, this was due to the rising costs and delivery problems faced by beneficiaries arising from the COVID-19 crisis and the war in Ukraine. Therefore, the duration of most Horizon 2020 projects had to be prolonged and final payments postponed to 2023.

On the first observation, under the established BOA for Information and Communication Technology (BOA ICT) with other Joint Undertakings in line with Article 13 of the Single Basic Act (SBA), the requested information is covered by means of the Common Annual Work Plan 2024 (adopted on 15 December 2023), which includes, among others, a specific action on the review and update of the BCP/DRP in 2024. The IHI JU leads the implementation of this action and the review and update of the common JU Business

[80] Ref. ARES(2023)8515994 – 12/12/2023

Continuity Plan (BCP) including the Disaster Recovery Plan (DRP) has been concluded in December 2024. The respective SLA[81] was signed on 03/04/2024.

On the second observation, the JU replied that as stated in last year's Annual Activity Report, project extensions were granted due to the impact of the COVID-19 pandemic. In some cases, the beneficiaries had to revise insufficient technical reports/deliverables or provide additional evidence of project results. Consequently, some interim and final payments of the JU's Horizon 2020 programme agenda had to be postponed, but the programme's completion remains on target for the end of 2024. EU-Rail JU is constantly monitoring projects to ensure the last payments and close the program as soon as possible. Nevertheless, the JU completed its operational activities under the Horizon 2020 programme by the end of 2023, as planned and even ahead of the Regulation deadline. To mitigate as much as possible the delays in technical activities, the JU together with its private members implemented an action plan in relation to payments to be implemented by June 2024. Due to some project specificities, there was a delay and it was closed by end of year leading to an implementation of €35.6 million in payments.

4.2.3. Overall Conclusions

In 2024, no critical findings/observations were issued for EU-Rail, neither by IAS, nor by ECA, which would indicate any serious issues or deficiencies with regard to the JU's risk management or to the design and implementation of its internal control system.

4.3. Assessment of the effectiveness of internal control systems

4.3.1. Continuous monitoring

In 2019, the JU started the process of implementing its new Internal Control Framework (ICF) based on the EC Internal Control Standards, also with the objective of introducing a more pro-active approach in the design and implementation of internal controls, rather than focusing mostly on the compliance aspects. This process resulted in 2020 in the adoption of a revised ICF by means of the Executive Director's Decision ED-20-08.

The JU's ICF is designed to provide reasonable assurance regarding the achievement of the following objectives:

- Effectiveness, efficiency and economy of operations;
- Reliability of reporting;
- Safeguarding of assets and information;
- Prevention, detection, correction and follow-up of fraud and irregularities;
- Adequate management of the risks relating to the legality and regularity of the underlying transactions, taking into account the multiannual character of the JU Programme as well as the nature of the payments concerned.

Ever since the revised ICF was adopted, it has been implemented by the Executive Director in the organisation's day-to-day activities, with the support of the Internal Control Coordinator, involving all staff across all JU functions as well. This process included also further fine-tuning of the internal controls and maintaining awareness among the staff of the ICF and its importance for achieving the JU's objectives.

The design of internal controls and their effective implementation is subject to continuous considerations and the ICF is amended, as deemed necessary. Such continuous monitoring is supplemented by annual in-depth self-assessment exercises aimed at comprehensive evaluation of the presence and functioning of all 17 internal control Principles, forming the five Components of the EU-Rail internal control system[82]:

1. Control environment
2. Risk assessment

[81] Ref. Ares (2024)2466793 – 04/04/2024

[82] The EU-Rail ICF is based on the COSO Internal Control Integrated Framework, also applied by the Commission services.

3. Control activities
4. Information and communication
5. Monitoring activities

The latest annual ICF self-assessment evaluating the situation in 2023 was conducted in Q1-Q2 2024. The assessment was carried out on the basis of 53 indicators and taking into account all relevant information available at that time, including the results from previous internal/external audits and the records in the JU's register of exceptions and non-compliance events.

After due assessment, no major or critical deficiencies in internal controls were identified. All individual ICF Principles as well as Components were found to be present and functioning. It is important to note that there have been some improvements especially related to Component no. 3 compared to last year in the sense that ECA findings were all implemented and closed in 2024 as well as the follow-up audit of open recommendations on Horizon 2020 grant implementation performed by IAS. However, feedback from staff survey suggests that supportive reporting lines and effective backup during periods of absence would help achieving operational and control objectives considering staff learning and development plans and existing workload. The JU is implementing remediation activities to tackle this observation related to Component no.3 and 4 of the internal control framework.

In addition, the exception reporting shows no evidence of exception events that have occurred in 2024. Thus, on this basis, it can be concluded that the JU's control system as a whole is present and functioning well.

4.3.2. Risk assessment and management

EU-Rail's risk assessment and risk management activities follow the principles of the recognised international standards and are aligned to the requirements of the Commission as indicated in its Communication SEC(2005)1327 "*Towards an effective and coherent risk management in the Commission services*"[83]. It is a continuous process involving clear communication to governance bodies, staff, and stakeholders on how EU-Rail positions itself in the management of risks and opportunities that can affect the achievement of its objectives, taking into consideration the assessment of the level of uncertainty that the JU is willing to accept (risk appetite). The Executive Director approves the policy and sets the tone, staff at the different levels implement the policy in the day-to-day operations. The Governing Board takes account of the most relevant risks and of the related action plan depicted in the JU's risk register, brought to its attention by means of the Consolidated Annual Activity Report and the Work Programmes.

Risk is defined as "*any event that could occur and adversely impact the achievement of the Joint Undertaking's strategic and operational objectives. Lost opportunities are also considered a risk*".

The Risk Management system aims at enabling informed decision making with the objective of optimising the ratio between the level of risk acceptable to the JU on one hand, and, on the other hand, the use of the relevant resources related to identifying, analysing, treating, and monitoring of risks and opportunities.

In 2024, in accordance with the JU's Policy for Risk Management as defined in its Governance and Process Handbook, the JU performed a risk assessment exercise with the aim of updating the elements related to risks and opportunities already included in its risk register, as well as identifying potential new ones. Within this exercise, due account was taken of topical internal and external factors and developments having influence on JU's business. Attention was given also to the fraud risks. The updated EU-Rail risk register for 2024 was shared with its parent Commission service – DG MOVE. EU-Rail actively participated within the respective cluster of JUs and Agencies in the peer review of the most important risks for 2025 steered by EUAN Performance Development Network.

The risks identified in the previous years' risk assessment activities which require, due to their criticality, continuous attention and treatment of the Executive Director and, where relevant, of the Governing Board, are presented in the JU Work Programme 2025-2026 and the follow-up outcomes on these risks will be present in the 2025 CAAR. Follow-up considerations applicable to the most relevant risks identified for 2024 are presented in Section 1.1 of this CAAR.

[83] https://commission.europa.eu/publications/risk-management_en

Further to the risk assessments exercises mentioned above, the IAS performed at EU-Rail their in-depth risk assessment which resulted in the establishment of their Strategic Internal Audit Plan 2024-2026 for the JU.

4.3.3. Prevention of Conflict of Interest

As for the treatment of potential conflicts of interests, and to implement the requirements following from its constituent act with regard to this matter, the JU has adopted the respective rules by means of its internal legal framework applicable to its managers, staff, as well as the members of its Governing Board. The annual declarations of interests of the latter are publicly available in the JU official website.

Thus, as it was the case in the past, EU-Rail will continue also in the future to apply various measures, such as:

- requiring annual declarations of interests from the staff members;
- obliging the independent experts used by the JU to declare any potentially conflicting interests;
- assessing potential conflicts of interests of persons (including those coming from outside of EU-Rail) involved in recruitment procedures, calls for proposals/tenders evaluations, etc.;
- requiring annual declaration of interests from the Governing Board members, as well as declaration of confidentiality and conflict of interest from all attendees to each EU-Rail's Governing Board meeting.

Furthermore, the JU Executive Director will continue in the practice of stressing to the staff and to the GB members the importance of compliance to the highest standards in ethical matters, including the situations potentially involving conflicts of interests. The JU's Internal Control Coordinator and HR Officer will support the ED in this respect, especially by engaging in awareness-raising activities addressing the EU-Rail staff.

4.4. Conclusion on the assurance

The EU-Rail Executive Director is not aware of any element that would bring him to introduce a reservation in this 2024 CAAR.

In addition to the specific supervisory activities carried out by the ED himself, the main elements supporting further the reasonable assurance related to the principle of sound financial management are:

- the Certificate of the Accounting Officer;
- the information received from the Head of Corporate Services, Head of the System Pillar Unit and ad interim Head of Programme, the Local Cybersecurity officer;
- the assessment of the Internal Control Framework carried out by the JU's Internal Control Coordinator;
- the results of the audit of the ECA;
- audits and risk assessments performed by the Internal Audit Service of the Commission;
- the overall risk management performed in 2024 and supervised by the ED;
- the assessment of the key performance indicators;
- the dedicated ex-ante controls of the JU's operational and administrative expenditure;
- the results from ex-post audits carried out by the Common Audit Service of DG RTD;
- the JU Members' reporting of their in-kind contributions/total project costs, as applicable;
- the monitoring and follow-up of the processes related to the calls for proposals/tenders;
- the deployment of independent external experts and observers in grant management;
- information reported in the JU's register of exceptions and non-compliance events and the related

- remedial measures put in place.

4.5. Statement of Assurance

4.5.1. Assessment of the Consolidated Annual Activity Report by the Governing Board

The ED submits the draft CAAR to the Joint Undertaking's Governing Board for assessment and approval. Once approved by the GB, the CAAR is made publicly available. No later than 1 July of each year the CAAR together with its assessment shall be sent by the Executive Director to the European Court of Auditors, to the Commission, to the European Parliament and to the Council.

The EU-Rail GB takes note of the results achieved and recommends the JU to continue improving its effectiveness and efficiency with the Members' stronger support.

4.5.2. Declaration of assurance

I, the undersigned, Giorgio Travaini, Executive Director of the Europe's Rail Joint Undertaking

In my capacity as authorising officer by delegation

Declare that the information contained in this report gives a true and fair view[84]*.*

State that I have reasonable assurance that the resources assigned to the activities described in this report have been used for their intended purpose and in accordance with the principles of sound financial management, and that the control procedures put in place give the necessary guarantees concerning the legality and regularity of the underlying transactions.

This reasonable assurance is based on my own judgement and on the information at my disposal, such as the results of the self-assessment, ex-post controls, the work of the Head of Corporate Services with the support of an external contractor in the absence of the Internal Control Coordinator, the observations of the Internal Audit Service and the lessons learnt from the reports of the Court of Auditors for years prior to the year of this declaration.

Confirm that I am not aware of anything not reported here which could harm the interests of the Joint Undertaking.

Brussels, 24 June 2024

Digitally signed by:

GIORGIO TRAVAINI

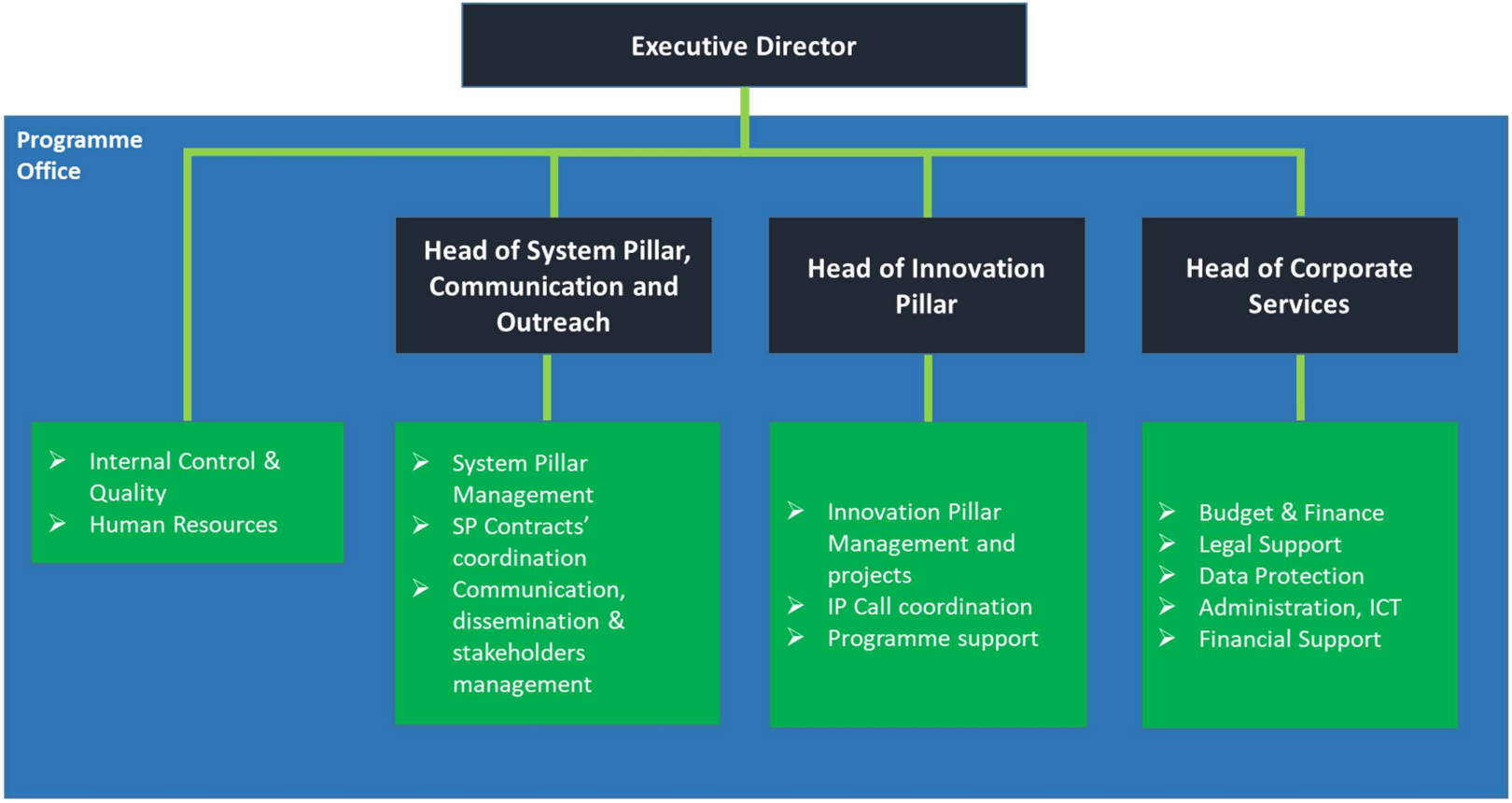
Date: 2025-06-24 12:13:08 UTC

Giorgio Travaini
Executive Director

[84] True and fair in this context means a reliable, complete, and correct view on the state of affairs in the Joint Undertaking.

5. ANNEXES

ANNEX A: Organisational structure of EU-Rail



ANNEX B: Establishment plan and additional information on HR management

Function group and grade	YEAR 2023				YEAR 2024			
	Authorised		Actually filled as of 31/12		Authorised		Actually filled as of 31/12	
	Perm. posts	Temp. posts	Perm. posts	Temp. posts	Perm. posts	Temp. posts	Perm. posts	Temp. posts
AD 16								
AD 15		1						
AD 14				(1)		1		1
AD 13								
AD 12								
AD 11								
AD 10		2		2		2		1
AD 9		1		1		1		1
AD 8		1		1		1		1
AD 7								
AD 6		4		4		4		4
AD 5		1		1		1		1
TOTAL AD	**10**		**9**		**10**		**9**	
AST 11								
AST10								
AST 9								
AST 8								
AST 7								
AST 6								
AST 5								
AST 4								
AST 3								
AST 2								
AST 1								
TOTAL AST								
AST/SC 6								
AST/SC 5								
AST/SC 4								

AST/SC 3								
AST/SC 2								
AST/SC 1								
TOTAL AST/SC								
GRAND TOTAL	**10**		**9**		**10**		**9**	

Contract Agents	**Authorized**	**Actually filled as of 31/12/2024**
Function Group IV	15	8
Function Group III	4	8
Function Group II	1	2
Function Group I		
TOTAL	20	18

Seconded National Experts	**Authorized**	**Actually filled as of 31/12/2024**
	2	2
TOTAL	2	2

The full staffing as per the JU's Staff Establishment Plan comprises 32 posts.

ANNEX C: Publications and external events participated to by the joint undertaking in 2024

Overview of publications and events

JU 2024 PUBLICATIONS

Title	Publication Date	Link to publication
Annual Activity Report 2023: Executive View	23 September 2024	https://rail-research.europa.eu/wp-content/uploads/2024/10/Europes-Rail-Annual-activity-report-2023_WEB.pdf
Catalogue of Solutions	23 September 2024	https://rail-research.europa.eu/solutions-catalogue

JU 2024 PRESS RELEASES

Title	Publication Date	Link to publication
Join us for 'The Future of Rail Freight – see how it works in the 21st century!' event	20 March 2024	https://rail-research.europa.eu/press-releases/join-us-for-the-future-of-rail-freight-see-how-it-works-in-the-21st-century-event/
Landmark event on the future of European rail freight boosts commitment for DAC	9 April 2024	https://rail-research.europa.eu/press-releases/landmark-event-on-the-future-of-european-rail-freight-boosts-commitment-for-dac/
Women in Rail Award 2024: Shaping the Future of Rail	17 April 2024	https://rail-research.europa.eu/press-releases/women-in-rail-award-2024-shaping-the-future-of-rail/
Europe's Rail awards seven grants for its Call for Proposals 2023	29 April 2024	https://rail-research.europa.eu/press-releases/europes-rail-awards-seven-grants-for-its-call-for-proposals-2023/
Europe's Rail names new Executive Director	28 May 2024	https://rail-research.europa.eu/press-releases/europes-rail-names-new-executive-director/

EU bodies join forces at InnoTrans 2024	25 September 2024	https://rail-research.europa.eu/press-releases/eu-bodies-join-forces-at-innotrans-2024/
Women in Rail 2024 Award: Harnessing Female Talent for a Competitive and Sustainable Future in Rail	27 September 2024	https://rail-research.europa.eu/press-releases/women-in-rail-2024-award-harnessing-female-talent-for-a-competitive-and-sustainable-future-in-rail/

JU 2024 NEWSLETTERS

Title	Publication Date	Link to Publication
Apply for Europe's Rail Call for Proposals 2024: January 2024 Newsletter	31 January 2024	https://mailchi.mp/rail-research.europa.eu/january2024newsletter
Apply for Europe's Rail Call for Proposals 2024: February 2024 Newsletter	29 February 2024	https://mailchi.mp/rail-research.europa.eu/february2024newsletter
Join us for the Connecting Europe Days on 2-5 April 2024 in Brussels: March 2024 Newsletter	27 March 2024	https://mailchi.mp/rail-research.europa.eu/march2024newsletter
Apply now for the Women in Rail Award 2024: April 2024 Newsletter	29 April 2024	https://mailchi.mp/rail-research.europa.eu/april2024newsletter-new
Improving Rail's Energy Supply and Consumption: May 2024 Newsletter	31 May 2024	https://mailchi.mp/rail-research.europa.eu/may2024newsletter
Apply now to our Call for Expression of interest to become EU-Rail Associated Members: June 2024 Newsletter	28 June 2024	https://mailchi.mp/rail-research.europa.eu/june2024newsletter
Meet us at InnoTrans: September 2024 Newsletter	18 September 2024	https://mailchi.mp/rail-research.europa.eu/september2024newsletter
Apply now to become an associated member of	30 October 2024	https://mailchi.mp/rail-research.europa.eu/october2024newsletter

Europe's Rail: October 2024 Newsletter		
Highlights from EU-Rail General Assembly: November 2024 Newsletter	29 November 2024	https://mailchi.mp/rail-research.europa.eu/november2024newsletter
Introducing the new EU-Rail Projects: December 2024 Newsletter	20 December 2024	https://mailchi.mp/rail-research.europa.eu/december2024newsletter

PRESS ARTICLES ABOUT THE JU PUBLISHED IN 2024

Press Outlet	Title	Link to the Publication
1. International Railway Journal	Three countries call on EU for Digital Automatic Coupler investment	1. https://www.railjournal.com/technology/three-countries-call-on-eu-for-digital-automatic-coupler-investment/#:~:text=AUSTRIA%2C%20Germany%20and%20Switzerland%20are,500%2C000%20freight%20wagons%20across%20Europe.
	Europe's Rail awards seven research grants worth €11.7m https://www.railjournal.com/news/carlo-borghini-to-depart-europes-rail/	2. https://www.railjournal.com/regions/europe/europes-rail-awards-seven-research-grants-worth-e11-7m/#:~:text=Funding%20is%20being%20provided%20for,by%20German%20Rail%20(DB).&text=THE%20Europe's%20Rail%20Joint%20Undertaking,for%20rail%20research%20and%20innovation.
	New executive director appointed at Europe's Rail	3. https://www.railjournal.com/regions/europe/new-executive-director-appointed-at-europes-rail/
	FRMCS moves forward	4. https://www.railjournal.com/in_depth/frmcs-moves-forward/
	Voith e-coupler selected as standard for Digital Automatic Coupler	5. https://www.railjournal.com/freight/voith-e-coupler-selected-as-standard-for-digital-automatic-coupler/

2. Euronews	How do you make Europe's rail network faster?	6. https://www.euronews.com/my-europe/2024/09/24/how-do-you-make-europes-rail-network-faster
3. Global Railway Review	Knowledge Hub: ESEP4Freight's contribution to rail freight information	7. https://edition.pagesuite-professional.co.uk/html5/reader/production/default.aspx?pubname=&edid=b45a09ca-8254-4e7a-8f53-69dd4900b2a6&pnum=40
	Women in Rail Award 2024: Shaping the future of rail	8. https://www.globalrailwayreview.com/news/170524/women-rail-award/
	ESEP4Freight– Shift to Rail in Freight Transport	9. https://www.globalrailwayreview.com/news/146542/esep4freight-shift-to-rail-in-freight-transport/
	The Right Track Podcast Series- Ep 6- Net Zero	10. https://www.globalrailwayreview.com/podcast/174334/the-right-track-podcast-series-ep-6-net-zero/
	From coupling to innovation: How DAC enables the full digital freight train vision	11. https://www.globalrailwayreview.com/article/197028/from-coupling-to-innovation-dac-enables-full-digital-freight-train-vision/
4. Railway Gazette	Crossing asset management research project launched	12. https://www.railwaygazette.com/research-training-and-skills/crossing-asset-management-research-project-launched/67627.article
	Train2InnoTrans highlights the need for cross-border co-operation	13. https://www.railwaygazette.com/train2innotrans-highlights-the-need-for-cross-border-co-operation/67445.article
	DAC programme agrees electrical coupler standard	14. https://www.railwaygazette.com/traction-and-rolling-stock/dac-programme-agrees-

		electrical-coupler-standard/67089.article
5. RailTarget	EU-Rail and European DAC Delivery Programme to Host Rail Freight Innovation Event	15. https://www.railtarget.eu/interviews-and-events/eurail-and-european-dac-delivery-programme-to-host-rail-freight-innovation-event-8055.html?fbclid=IwAR388yexmSZiJRgrIQiWehkLXroHXmplfjrDEtEUsFBnDy5LkmK87sP40C8
	On Track for Transformation: European Rail Freight Enters a New Digital Era	16. https://www.railtarget.eu/technologies-and-infrastructure/on-track-for-transformation-european-rail-freight-enters-a-new-digital-era-8202.html?fbclid=IwZXh0bgNhZW0CMTEAAR1yFFtZ2CbUfUF4pf0T-7zcXbgvfhHhvzj8EQERoeUflr509ZbnnU7sAnQ_aem_AaA_qXMgCSCsxrXajapZDeY1Yv_I8wnIFbpDvMC_SXPYJp6KIYNnHOfswxed_vOhBdyFilb6Q2DbJ2215Nlps27A
	LIVE COVERAGE: 'Renew – Up to Date on Digital Rail Freight' Webinar	17. https://www.railtarget.eu/interviews-and-events/live-coverage-renew-up-to-date-on-digital-rail-freight-webinar-8178.html?fbclid=IwZXh0bgNhZW0CMTEAAR2nyjhmznjxjb8paVCvTUJl91otspOdnYYiGFugAOySrYpwzWh8e7Kxvtw_aem_AaCJ1Oak2Bv3is3-snatqp0X_TMkywJNGMfw9K-2cf-GPtiU8ZZXvm5rdU6IEfVZf72-EzfREpHzw4ZBIdB9yLgX
	LIVE COVERAGE: 'The Future of Rail Freight – See How It Works in the 21st Century'	18. https://www.railtarget.eu/interviews-and-events/live-coverage-the-future-of-rail-freight-see-how-it-works-in-the-21st-century-8121.html
	Europe's Rail Unveils EUR 21.2 Million Investment in Seven Cutting-Edge Rail Projects	19. https://www.railtarget.eu/business/europes-rail-unveils-eur-212-million-investment-in-seven-cuttingedge-rail-projects-

		8335.html?fbclid=IwZXh0bgNhZW0CMTEAAR1f4ayYUlJFqzcDghrmreBssXDQLmJZNDySixd8RUVtbxJ7goXAdAz1mRI_aem_AUQNDiSRITI2J4WMpQHES-HAjImKwBy7JRuIEFX_x21JbML2FYzRsKmXn1rwxhfcHil5Zk8rsURZhh_xppEs9CL6
	EU-Rail Appoints Experienced Leader Giorgio Travaini as Executive Director	20. https://www.railtarget.eu/business/eurail-appoints-experienced-leader-giorgio-travaini-as-executive-director-8526.html?fbclid=IwZXh0bgNhZW0CMTEAAR2Sg0Tg8Qum9qfQt4jcmo5dhAGjq8RjDs_T1QImuDwQWbTdvuS1RSk1eVM_aem_ARWt_zEigqVHI8hic_90xjYtfv6thkHeCf6Uk4_3M07l5gli2Fr5PiX1UpJgjsAJq5_BKqm6H5hfsdNwz1tNU5x_
	EU-Rail Launches Call for Expression of Interest to Select New Associated Members	21. https://www.railtarget.eu/business/eurail-launches-call-for-expression-of-interest-to-select-new-associated-members-8797.html
6. Railway Technology	EU-Rail awards €11.7m in grants for seven research projects	22. https://www.railway-technology.com/news/eu-rail-grants-seven-research-projects/
	Voith wins race for European DAC solution	23. https://www.railway-technology.com/news/voith-wins-race-for-european-dac-solution/
7. Euractive	Creating a Single European Rail Area – we have the vision, now it's about implementation, says Travaini	24. https://www.euractiv.com/section/eet/interview/creating-a-single-european-rail-area-we-have-the-vision-now-its-about-implementation-says-travaini/
	On the right track, European rail sector unites, integrating for digital era	25. https://www.euractiv.com/section/railways/news/on-the-right-track-european-rail-sector-

		unites-integrating-for-digital-era/
8. Knorr-Bremse Technical Articles	Digital Freight Train: Challenges of interoperable automation to increase efficiency in the Freight Rail Sector	26. https://rail.knorr-bremse.com/en/de/stories/technical-articles/content-page-3.json
9. Yahoo Finance	EU-Rail awards €11.7m in grants for seven research projects	27. https://finance.yahoo.com/news/eu-rail-awards-11-7m-161226470.html
10. MaaS Alliance	Commission and EU rail sector launch Women in Rail Award 2024	28. https://maas-alliance.eu/2024/05/03/commission-and-eu-rail-sector-launch-women-in-rail-award-2024/
11. fundsforNGOs	Call for Nominations: Women in Rail Award 2024	29. https://www2.fundsforngos.org/education/call-for-nominations-women-in-rail-award-2024/
12. Travel and Tour World	Europe's Rail Appoints Giorgio Travaini as New Executive Director	30. https://www.travelandtourworld.com/news/article/europes-rail-appoints-giorgio-travaini-as-new-executive-director/
	InnoTrans 2024 Highlights Women's Pivotal Roles in Rail at the European Commission-Hosted Ceremony	31. https://www.travelandtourworld.com/news/article/innotrans-2024-highlights-womens-pivotal-roles-in-rail-at-the-european-commission-hosted-ceremony/
13. RailFreight.com	Where will the data from the Digital Automatic Coupling go?	32. https://www.railfreight.com/specials/2024/11/20/where-will-the-data-from-the-digital-automatic-coupling-go/?gdpr=accept
	Voith's e-coupler selected as the basis for Digital Automatic Couplers	33. https://www.railfreight.com/technology/2024/07/19/voiths-e-coupler-selected-as-the-basis-for-digital-automatic-couplers/

14. Railways Africa	E-Coupler From Voith Sets Benchmarks For Freight Transportation	34. https://www.railwaysafrica.com/news/e-coupler-from-voith-sets-benchmarks-for-freight-transportation
15. CORDIS	Air Traffic Management and the Green Deal	35. https://cordis.europa.eu/article/id/451354-air-traffic-management-and-the-green-deal
16. Rete Ferroviaria Italiana	Pioneering maglev-derived systems for Rail: MaDe4Rail project presents breakthrough results at InnoTrans 2024	36. https://www.rfi.it/en/News/news-online/2024/9/30/pioneering-maglev-derived-systems-for-rail--made4rail-project-pr.html
17. mynewsdesk	Digital automatic couplers are now being tested in Sweden's heaviest freight train	37. https://www.mynewsdesk.com/greencargo/pressreleases/digital-automatic-couplers-are-now-being-tested-in-swedens-heaviest-freight-train-3361033?utm_source=rss&utm_medium=rss&utm_campaign=Alert&utm_content=pressrelease
18. Energetyka 24	It's the turn of hydrogen. H2 will change rail transport [ANALYSIS]	38. https://energetyka24.com/elektromobilnosc/analizy-i-komentarze/kolej-na-wodor-h2-odmieni-transport-kolejowy-analiza
19. Leichtbauwelt	Rail vehicles: Wheelset frames made of CFRP are half lighter	39. https://www.leichtbauwelt.de/schienenfahrzeuge-radsatzrahmen-aus-cfk-um-die-haelfte-leichter/
20. Przegląd Komunikacyjny	European Institutionalised Rail Partnership – Europe's Rail Joint Undertaking	40. https://www.transportation.overview.pwr.edu.pl/UPLOAD/CALE-NUMERY/NUMERY-PL/2023/N_PK_11_12_23.pdf
21. Revue Générale des Chemins de Fer	Le Pilier Système européen : l'avenir du ferroviaire s'écrit en commun	41. https://www.revue-rgcf.com/revues/numero-346/
	Le déploiement d'un attelage automatique et numérique dans le fret ferroviaire en Europe	42. https://www.revue-rgcf.com/revues/numero-347/

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23. SRF news	SBB is testing remote-controlled locomotives for the first time	44. https://www.srf.ch/news/schweiz/automatisierte-zuege-sbb-testet-erstmals-ferngesteuerte-lok
24. SBB CFF FSS	Les CFF ont effectué des essais en exploitation avec une locomotive télécommandée	45. https://news.sbb.ch/fr/medias/article/127574/les-cff-ont-effectue-des-essais-en-exploitation-avec-une-locomotive-telecommandee
25. OEBB Presse	Digital Automatic Coupling in Europe: DA-CH for rapid introduction and joint financing	46. https://presse-oebb.at/news-digitale-automatische-kupplung-in-europa-d-a-ch-fuer-rasche-einfuehrung-und-gemeinsame-finanzierung?id=199216&menueid=27019&l=deutsch
26. Trafikverket	Dark fiber can contribute to better infrastructure	47. https://bransch.trafikverket.se/om-oss/aktuellt-for-dig-i-branschen3/aktuellt-om-forskning-och-innovation2/2024-05/mork-fiber-kan-bidra-till-battre-infrastruktur/
	The Swedish Transport Administration is contributing to the development of battery-electric trains for passenger transport by rail in Europe	48. https://bransch.trafikverket.se/om-oss/aktuellt-for-dig-i-branschen3/aktuellt-for-dig-i-branschen/2024-05/trafikverket-bidrar-till-utvecklingen-av-batterielektriska-tag-for-passagerartransporter-pa-jarnvag-i-europa/
	Research into reduced air resistance for reduced energy consumption	49. https://bransch.trafikverket.se/om-oss/aktuellt-for-dig-i-branschen3/aktuellt-om-forskning-och-innovation2/2024-09/forskning-kring-minskat-

		luftmotstand-for-reducerad-energiforbrukning/
	En bättre järnväg genom optimerad planering och operativ förvaltning	50. https://bransch.trafikverket.se/om-oss/aktuellt-for-dig-i-branschen3/aktuellt-for-dig-i-branschen/2024-10/en-battre-jarnvag-genom-optimerad-planering-och-operativ-forvaltning/
	Forskning kring rullande materiel på järnväg	51. https://bransch.trafikverket.se/om-oss/aktuellt-for-dig-i-branschen3/aktuellt-om-forskning-och-innovation2/2024-10/forskning-kring-rullande-materiel/
	Ökad kunskap för en klimatsäkrad järnväg	52. https://bransch.trafikverket.se/om-oss/aktuellt-for-dig-i-branschen3/aktuellt-for-dig-i-branschen/2024-11/okad-kunskap-for-en-klimatsakrad-jarnvag/
	Ny forskning bidrar till bättre luft på plattformar under jord	53. https://bransch.trafikverket.se/om-oss/aktuellt-for-dig-i-branschen3/aktuellt-for-dig-i-branschen/2024-10/ny-forskning-bidrar-till-battre-luft-pa-plattformar-under-jord/
	Standarder - ansvarsfull hantering av skattemedel	54. https://bransch.trafikverket.se/om-oss/aktuellt-for-dig-i-branschen3/aktuellt-for-dig-i-branschen/2024-11/standarder---ansvarsfull-hantering-av-skattemedel
27. FerPress	EU-Rail: il CdA nomina Giorgio Travaini nuovo direttore esecutivo	55. https://www.ferpress.it/eu-rail-il-cda-nomina-giorgio-travaini-nuovo-direttore-esecutivo/
28. ildenaro.it	Giorgio Travaini promosso da EU-Rail al ruolo di direttore esecutivo	56. https://www.ildenaro.it/giorgio-travaini-promosso-da-eu-rail-al-ruolo-di-direttore-esecutivo/

29. Lazio Innova	Women in Rail Awards 2024	57. https://www.lazioinnova.it/news/women-in-rail-awards-2024/
30. Virgilio	Giorgio Travaini promosso da EU - Rail al ruolo di direttore esecutivo	58. https://www.virgilio.it/italia/napoli/notizielocali/giorgio_travaini_promosso_da_eu_rail_al_ruolo_di_direttore_esecutivo-73401270.html
31. Vialibre	EU-Rail concede 11,7 millones de euros en subvenciones para siete proyectos de investigación	59. https://www.vialibre-ffe.com/noticias.asp?not=42032&cs=inte
32. Cluster Trasporti	Travaini nuovo direttore esecutivo di Eu-Rail	60. https://www.clustertrasporti.it/travaini-nuovo-direttore-esecutivo-di-eu-rail/
33. Strukton	ERTMS Trackbot	61. https://struktonrail.nl/innovaties/ertms-trackbot/
34. FS News	La partecipazione del Gruppo FS nella trasformazione del trasporto ferroviaria europeo	62. https://www.fsnews.it/it/focus-on/corporate/2024/10/17/fs-europe-s-rail-innotrans-2024.html
	Europe's Rail, FS a InnoTrans 2024	63. https://www.fsnews.it/it/focus-on/corporate/2024/10/17/fs-europe-s-rail-innotrans-2024.html
35. Järnvägsnyheter.se	Framtidens digitala godståg testas i Sverige	64. https://www.jarnvagsnyheter.se/20240923/16620/framtidens-digitala-godstag-testas-i-sverige
36. Süddeutsche Zeitung	Europaweites Projekt:„Unglaublich gute Empfehlungen“	65. https://www.sueddeutsche.de/muenchen/erding/dorfen-bahnhof-abs-38-tum-rail4citis-entwicklung-projekt-studenten-lux.XJcPbmG7SLEdRLW67ihnde
37. Merkur	Mailand, Toulouse, Dorfen – die Zukunft der Bahnhöfe	66. https://www.merkur.de/lokales/erding/dorfen-ort28598/dorfen-mailand-

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38. Mafex	Ceit desarrolla un sistema de monitorización para desvíos ferroviarios	67. https://magazine.mafex.es/wp-content/uploads/2024/09/maqueta_castellano.pdf

Events participated to by the Joint Undertaking in 2024

In 2024, the JU participated to major events across Europe and beyond, presenting concrete results achieved by JU Members together with other key stakeholders.

Webinar on the EU-Rail Standardisation and TSI Input Plan, 11 January, online

The Europe's Rail System Pillar organized a webinar on EU-Rail's Standardisation and Technical Specifications for Interoperability (TSI) Input Plan on 11 January. Gathering over 200 participants, the webinar demonstrated the context and approach of the Standardisation and TSI Input Plan (STIP), including its topic assessment, structuring, and review.

International Rail Passengers Transport Meeting, 16 January, online

Executive Director a.i. participated in the first plenary meeting of the Platform for International Rail Passenger Transport on 16 January 2024 in Luxembourg. Established following the Ministers' Declaration in June 2020, the platform benefits from Europe's Rail contributions to the potential uptake of its research and innovation activities. In addition to discussions on enhancing the passenger experience on both classic and high-speed international rail services, the meeting confirmed the platform's 2024 programme and marked the start of its activities for the year.

SNS JU Call for Proposals Info Day, 22 January 2024, online

The Smart Networks and Services Joint Undertaking (SNS JU) organised an Info Day on 22 January 2024, providing a detailed overview of the SNS JU Call ambitions, focus, and selection criteria while supporting those interested in submitting a proposal. Our Senior Programme Manager joined the webinar to present the synergies between SNS JU and Europe's Rail on digital and automated testing and operational validation of the next rail communication system.

ITF Annual Consultation with International Organisations, 31 January, Paris, France

Europe's Rail participated in the 2024 ITF Annual Consultations with International Organisations on 31 January in Paris, represented by our Senior Programme Manager. The event provided an opportunity for invited organisations to comment on the proposed sessions for the 2024 ITF Summit 'Greening Transport: Keeping Focus in Times of Crisis,' scheduled for 22-24 May in Leipzig, Germany, and to suggest additional topics for inclusion. In the afternoon, participants were introduced to the 2025 ITF Summit theme, which will focus on 'Enhancing Transport Resilience to Global Shocks.'

Europe's Rail Call for Proposals 2024 Info Day, 9 February 2024, online

The Info Day 2024 took place online on 9 February at 10:00 CET, providing an overview of the aims of Europe's Rail Research and Innovation Programme and introducing opportunities for involvement in making rail a more attractive transport mode for both people and businesses in Europe. Participants gained insights into the Call topics as well as legal and financial considerations. As in the previous Call for Proposals, a dedicated platform was launched, enabling registered participants to engage in long-term matchmaking by sharing competencies, skills, and topics of interest to connect with like-minded experts.

Smart Rail Innovation Conference, 20 March, online

Executive Director a.i. participated in the 'Rails, Rules, and Regulations: Crafting Policy and Standards for Canada's Railways' panel at the Smart Rail Innovation Conference on 20 March. The event brought

together industry experts, innovators, policymakers, and stakeholders to explore the latest advancements and challenges in smart rail innovation in Canada.

UTP's Rail System Committee Meeting, 26 March, online

Acting Executive Director participated in UTP's Rail System Committee meeting on 26 March in Paris, France, where he provided an update on the latest developments of the EU-Rail Research and Innovation Programme and presented the Call for Proposals 2024. The meeting also served as a platform to discuss key European technical and political topics relevant to railway operators and infrastructure managers in France.

International Rail Passengers Workshop, 27 March, online

Our Senior Programme Manager participated in the International Rail Passengers (IRP) online workshop on 27 March, which focused on multimodal transport. During the session, she presented the Europe's Rail Joint Call with SESAR 3 Joint Undertaking, published the previous year, which supports the development of an 'Integrated Air and Rail Network Backbone for a Sustainable and Energy-Efficient Multimodal Transport System'.

Connecting Europe Days, 2-5 April, Brussels, Belgium

Europe's Rail participated in the Connecting Europe Days 2024, Europe's mobility flagship event, held on 2-5 April in Brussels, Belgium. The European DAC Delivery Programme, enabled by Europe's Rail, organised the side event 'The Future of Rail Freight – See How It Works in the 21st Century!' on 2 April at 11:00 CET at Train World, under the Belgian Presidency of the Council of the European Union. High-level European transport stakeholders discussed the future of rail freight, accompanied by a live demonstration showcasing the opportunities offered by rail automation through Digital Automatic Coupling (DAC).

Europe's Rail Executive Director a.i., spoke in the session 'Revolutionising Infrastructure: Paving the Way for Sustainable, Resilient and Future-Proof Freight Transport,' focusing on the physical and digital requirements for zero-emission, connected, and resilient freight transport. On 4 April Senior Programme Manager participated in the session 'Innovations That Will Change the Face of Rail: How New Technology Opens a New Era for the Rail Sector,' exploring the introduction of emerging technologies in rail, including Automated Train Operation (ATO), the implementation of DAC, and the transition from traditional radio systems to the Future Railway Mobile Communication System (FRMCS), complemented by satellite technology.

Transport Research Arena (TRA), 15-18 April 2024, Dublin, Ireland

Europe's Rail participated in the Transport Research Arena 2024, Europe's leading transport event, held in Dublin, Ireland, from 15-18 April under the theme *'Transport Transitions: Advancing Sustainable and Inclusive Mobility'.* For the first time, EU-Rail shared a stand with Clean Hydrogen JU, Clean Aviation JU, and SESAR JU, underscoring the importance of synergies in Research and Innovation for transportation. Throughout the event, EU-Rail organised special sessions, including discussions on the evolution of a common European Rail Traffic Management System, the role of prescriptive and predictive maintenance in transport, and disruptive guided transport solutions for Europe's future mobility. Additionally, the Executive Director a.i. participated in a strategic session on *'Connected, Cooperative and Automated Mobility: What Next for New Mobility Services?'* which focused on developments in CCAM since 2018 and the future of transport megatrends.

The event provided a valuable platform to explore mobility trends across Europe, share industry achievements, and discuss how research and innovation can reshape transport and mobility systems. EU-Rail was also proud to support the TRA Visions Young Scientists Competition, where the Executive Director a.i. awarded the Young Scientists winner. Furthermore, in collaboration with ERRAC and EURNEX, Europe's Rail hosted the Student Competition award ceremony, aimed at facilitating access to the railway industry for young professionals and recent graduates in railway studies.

ERTMS Conference, 23-25 April, Valenciennes, France

The ERTMS 2024 Conference, hosted by the European Union Agency for Railways (ERA) from 23 to 25 April in Valenciennes, France, focused on the deployment of the European Rail Traffic Management System (ERTMS) across Europe, highlighting lessons from successful projects, current deployment status, and future perspectives. Europe's Rail actively contributed, with its Acting Executive Director, Head of

System Pillar, and Senior Programme Manager presenting the outcomes and objectives of its System and Innovation Pillars during Session 6 on 25 April. Additionally, its Programme Manager and Seconded National Expert led a workshop on Digital Automatic Coupling (DAC), showcasing the programme's progress and its interface with ERTMS, particularly in harmonising operational rules and Safe Train Length/Integrity functionality. The conference also addressed migration strategies for the Future Railway Mobile Communication System (FRMCS) and advancements in Control Command and Signalling Technical Specifications for Interoperability (CSS TSI), bringing together key industry stakeholders to drive the future of rail signalling and communication.

Flagship Project 5 TRANS4M-R Mid-term Plenary, 16 May, Vienna, Austria

The Europe's Rail Flagship Project 5 (FP5) TRANS4M-R held its mid-term plenary on 16 May 2024 in Vienna, Austria, focusing on Full Digital Freight Train Operations and Seamless Freight. The event brought together key stakeholders to assess progress and discuss future developments in digital freight innovation.

Our Senior Programme Manager participated in a panel discussion on the past and future milestones of collaboration between the Europe's Rail Innovation Pillar, System Pillar, and the European DAC Delivery Programme. The plenary provided a platform for in-depth exchanges on advancing digital solutions for freight transport.

International Rail Passenger (IRP) Plenary, 16 May, online

Our Executive Director participated in the International Rail Passenger (IRP) Plenary Meeting on 16 May 2024, which focused on the 2024 Progress Report. The IRP platform facilitates cooperation between Member States, the European Commission, industry stakeholders, and passenger representatives to advance an interconnected and competitive rail network. The discussions centred on promoting sustainability, supporting Green Deal objectives, enhancing mobility, and improving connectivity across all regions.

European Rail Research Advisory Council (ERRAC) Plenary, 22 May, Brussels, Belgium

Europe's Rail participated in the European Rail Research Advisory Council (ERRAC) Plenary on 22 May in Brussels, Belgium. Our Programme Manager delivered a keynote speech on the Europe's Rail Programme and its ongoing activities, providing insights into the latest developments in rail research and innovation.

Additionally, our Head of System Pillar addressed the audience to congratulate the winners of the student competition, an initiative jointly launched by ERRAC, Europe's Rail, and EURNEX to support young talent and foster innovation in the railway sector.

ITF Summit, 22-24 May, Leipzig, Germany

Executive Director participated in the International Transport Forum (ITF) Summit 2024 from 22 to 24 May in Leipzig, Germany, where discussions focused on the transport sector's role in environmental sustainability and the impact of climate, health, and geopolitical crises.

As part of the summit, he joined a panel discussion on the EU's support for Digital Automatic Coupling (DAC), highlighting its importance for the future of rail freight despite current challenges. Additionally, he participated in a session titled 'Digital Infrastructure Promoting Climate-Proof and Resilient Transport', emphasizing the role of digitalisation in building a more sustainable and resilient transport system.

System Pillar Engagement Workshop, 23 May, Brussels, Belgium

The Europe's Rail System Pillar Engagement Workshop took place on 23 May 2024 in Brussels, Belgium, providing an opportunity to gain deeper insights into the work of the System Pillar and engage with its experts. Discussions covered key topics, including the Single European Railway Area and the Standardised Railway System Architecture, among others, fostering dialogue on the future development of a more integrated and efficient European rail system.

UIP Keepers Summit, 30 May, Venice, Italy

Executive Director participated in the UIP Keepers' Summit on 30 May in Venice, Italy, joining a panel discussion on Digital Automatic Coupling (DAC), a key technology for automating rail freight transport and enhancing its efficiency for the 21st century. The summit, an annual conference dedicated to rail freight interests, provided a platform for the rail freight community to engage with representatives from national ministries, the European Parliament, and the European Commission. Discussions focused on leveraging

new technologies to revitalise wagonload traffic, improve service quality, and strengthen the resilience and attractiveness of rail freight.

Batteries Europe Plenary Session, 11 June, online

Executive Director participated in a panel during the Batteries Europe Plenary Session on 11 June, contributing to discussions on the role of batteries in achieving full transport decarbonisation. The panel, titled 'The Role of Batteries in the Future Scenario of Full Decarbonisation of Transport', explored future applications of battery technology across various transport sectors.

European Rail Supply Industry Association (UNIFE) General Assembly, 13 June, Brussels, Belgium

Executive Director participated in the UNIFE General Assembly on 13 June in Brussels, Belgium, contributing to discussions on achieving a net-zero European Union. He joined a panel alongside representatives from the European Commission (DG GROW), Alstom, Lucchini RS, and Wabtec Corporation to explore how Europe's Rail ensures alignment between industrial and climate policies to support a competitive European Rail Supply Industry.

Highlighting Europe's Rail's role in advancing research and innovation (R&I), he emphasised the organisation's contribution to competitiveness and sustainability in transport and mobility solutions. As Europe moves toward net-zero emissions, EU-Rail remains a key enabler, working closely with its partners to drive the transformation of the rail sector.

Rail Data Forum, 18-19 June, Verona, Italy

Head of System Pillar delivered a keynote speech at the Rail Data Forum 2024, organised by the European Union Agency for Railways (ERA) on 18-19 June in Verona, Italy.

The event focused on the role of semantic technologies in structuring and interconnecting railway data, enhancing data quality, and advancing the FAIR principles – findable, accessible, interoperable, and reusable – to support a more efficient and digitalized rail sector.

UPM Summer School – Railways: the safest transport mode, 26 June, online

Our Executive Director presented the Europe's Rail programme and priorities at the UPC Summer School on 26 June. The course explored the evolution of railways, examining key components and their development over time, as well as the role of rail in passenger and freight transportation.

Additionally, the programme highlighted innovative technologies shaping the sector, including advancements in safety, energy efficiency, digitisation, resilience, and sustainability. The session provided valuable insights into how research and innovation are driving the future of rail transport.

ERA's 2024 flagship reports event, 2 July, Brussels, Belgium

Our Executive Director participated in the launch of ERA's 2024 Flagship Reports event on 2 July in Brussels, Belgium, where the European Union Agency for Railways (ERA) released two major reports: the 2024 Safety and Interoperability Monitoring Report and the Rail Environmental Report.

ETCR Seminar on EU Transport Policy and Railway Affairs, 8 July, Bruges, Belgium

Executive Director participated in a panel on digital railways during the annual seminar of the European Training Centre for Railways (ETCR) on 8 July in Bruges, Belgium.

This two-week event, organised by ETCR, the College of Europe, and the European Union Agency for Railways, provided an in-depth overview of the latest developments in the European railway sector, fostering discussions on innovation, policy, and future trends in rail transport.

Hyperloop Conference, 10 September, Rotterdam, the Netherlands

On 10 September 2024, our Executive Director delivered the opening keynote 'Status Update Hyperloop Ecosystem' at the Hyperloop Conference 2024 in Rotterdam. The event gathered key stakeholders from the hyperloop ecosystem, including start-ups, corporates, suppliers, and investors, to discuss advancements in high-speed transportation.

Additionally, our Programme Manager participated in the panel discussion 'Why Joining Forces Is a Good Idea in an Evolving but Competitive Market', highlighting the importance of collaboration in driving innovation and accelerating the development of hyperloop technology. The conference provided a platform for industry leaders to exchange insights on the future of sustainable, high-speed transport solutions.

International Railway Safety Conference (IRSC) 2024, 17-21 September, Vienna, Austria

Executive Director participated in the International Railway Safety Council from 17 to 21 September in Vienna, Austria.

The conference explored safety culture and new technologies from various perspectives, highlighting the intersection of safety, innovation, and sustainability in the railway sector. Discussions focused on the latest advancements in railway safety and the role of innovation in enhancing operational resilience and efficiency.

Women in Rail Award, 24 September 2024, Berlin, Germany

On 24 September 2024, Europe's Rail supported the *Women in Rail 2024 Award*, recognising outstanding contributions of women in the railway sector and promoting gender diversity as a key factor for competitiveness and sustainability. The event celebrated the achievements of women in rail, highlighting their role in driving innovation and leadership within the industry.

Aligned with Europe's Rail's commitment to diversity and inclusion, the award served as a platform to showcase role models and emphasise the value of diverse perspectives in shaping the future of rail transport. The initiative reinforced the importance of gender balance in fostering a resilient, innovative, and forward-thinking rail ecosystem.

Women in Mobility Luncheon, 24 September 2024, Berlin, Germany

The Women in Mobility (WiM) Luncheon took place on 24 September at Palais am Funkturm during InnoTrans 2024, continuing its tradition as a key networking event since its first edition in 2016. With over 800 participants attending, the event highlighted the importance of diversity in driving innovation within the mobility sector.

Europe's Rail Governing Board Member delivered a keynote speech, emphasising the role of female leadership in shaping the future of transport. The luncheon aimed to showcase female role models, enhance visibility, and inspire greater inclusion within the industry.

DAC Event at InnoTrans, 26 September 2024, Berlin Germany

As part of InnoTrans 2024, a visit to the Train Test Lab in Berlin-Spandau was organized to showcase the progress of Europe's Rail Flagship Project 5 (FP5) TRANS4M-R. Participants had the opportunity to experience firsthand the advancements in Digital Automatic Coupling (DAC) through a series of live demonstrations led by experts in operations, testing, and authorization.

The event brought together high-level stakeholders from across the rail sector, including representatives from government, industry, and the European Commission. The demonstrations highlighted the potential of DAC technology to enhance efficiency and automation in rail freight, reinforcing its role in shaping the future of European rail transport.

InnoTrans 24-27 September 2024, Berlin, Germany

Europe's Rail participated in InnoTrans 2024, the leading international trade fair for transport technology, held from 24-27 September in Berlin, Germany. With a 210 sqm joint stand shared with DG MOVE and the European Union Agency for Railways (ERA), Europe's Rail showcased its latest research and innovation projects, highlighting key advancements in railway technology. The event provided a platform for engagement with industry leaders, policymakers, and stakeholders, fostering discussions on the future of sustainable and digital rail transport.

Throughout the exhibition, Europe's Rail organised and participated in various sessions and panel discussions, addressing critical topics such as rail digitalisation, automation, multimodal transport integration, and sustainability. Experts from Europe's Rail presented the latest developments in the System and Innovation Pillars, emphasising the role of research and innovation in shaping the future of European rail. These sessions also explored collaboration opportunities with key industry players to drive forward seamless and efficient railway solutions.

During InnoTrans 2024 on 24 and 25 September, Europe's Rail organized Guided Tours showcasing the impact of EU-Rail and Shift2Rail research and innovation on real-world rail solutions developed by its Members and partners. Participants had the opportunity to engage directly with experts and explore cutting-edge innovations, including the Flexx & Distance Master, various models of the Digital Automatic Coupler (DAC), the ERTMS Trackbot, and more. These tours provided a unique platform to connect with Europe's Rail Founding Members, ask questions, and gain insights into how these advancements contribute to making rail the preferred mode of everyday mobility.

EUAN exhibition at the European Parliament, 30 September – 3 October, Brussels, Belgium

EU-Rail attended the EUAN event organised for agencies at the European Parliament on 30th September to 3rd October, with a dedicated exhibition and demo section showcasing examples of new solutions developed in our Programme. This gave us the opportunity to liaise with MEPs and to start discussions on the future joint JU event to be organised in the spring 2025 at the European Parliament.

European Mobility Expo, 2 October 2024, Brussels, Belgium

On 2 October 2024, Executive Director participated in two sessions on rail freight competitiveness and digital innovations for customers.

The first session focused on the EU framework to support rail freight competitiveness, bringing together key industry and environmental stakeholders to discuss policies and strategies to enhance rail freight's role in the transport sector. Later, he joined a discussion on the role of digitalisation in customer relationships, exploring how digital innovations can improve passenger experience, strengthen engagement, and enhance rail's overall appeal.

Info Day on Call for Expression of Interest to become a Europe's Rail associated member, 4 October 2024, online

Europe's Rail hosted an Info Day on its Call for Expression of Interest to become an EU-Rail Associated Member. The online session provided insights into the criteria and procedures for membership applications, as well as the rights and responsibilities of private members. Participants had the opportunity to learn about joining this dynamic partnership to contribute to safer, more efficient, and sustainable rail transport.

ERTMS Forum, 9-10 October 2024, the Netherlands

Our Programme Manager participated in the European Rail Traffic Management System (ERTMS) Forum in the Netherlands on 9-10 October, where stakeholders discussed the latest developments in ERTMS implementation across EU member states. During the event, he presented on the deployment of the Future Rail Mobile Communication System (FRMCS) and highlighted the role of Europe's Rail's new high-level deployment group, which provides strategic recommendations to the Governing Board on implementing innovative rail solutions, with FRMCS deployment as its first focus.

Discussions at the forum addressed common challenges such as high costs, evolving specifications, and data-sharing regulations. To tackle these issues, it was agreed that closer collaboration between the Deployment Group and the ERTMS Forum would be essential. This partnership aims to ensure alignment on risk assessments and timelines, avoid duplicate investments, and manage the interdependencies of ERTMS and FRMCS transformations during deployment.

6th SmartRaCon Scientific Seminar, 23-24 October 2024, online

The 6th Smart Rail Control (SmartRaCon) Scientific Seminar took place in San Sebastián, Spain, on 23-24 October. Our Executive Director opened the event with a video message, extending his best wishes for a productive exchange.

On the second day, our Senior Programme Manager participated in an industry roundtable discussion, presenting the work of Europe's Rail and contributing to discussions on advancements in rail control and innovation.

STAFFER Final Event, 24 October, Brussels, Belgium

On 24 October, our Executive Director attended the concluding event of the STAFFER project, where he joined key industry and institutional representatives to discuss the STAFFER Strategy & Action Plan. The

session explored how the project's legacy will contribute to advancing rail innovation and addressing future workforce challenges in the sector.

Alongside representatives from DG MOVE, the European Union Agency for Railways, the CER, and UNIFE, the discussion focused on ensuring that the project's outcomes support the development of skills, training, and innovation necessary for the rail industry's future.

Railway Days Investment Summit, 29-30 October 2024, Bucharest, Romania

Our Senior Programme Manager participated in the Railway Days Investment Summit in Bucharest, Romania, on 29-30 October, contributing to discussions on strengthening rail's market position.

As part of a panel on the transport market, he engaged in discussions on legislative, regulatory, and financial strategies to expand rail's market share. The panel also explored the state's role in promoting rail, infrastructure access and fees, and the importance of a balanced approach to intermodal transport.

European Railway Agency (ERA) Budapest Workshop 2024, 16 October, online

Organised by the European Union Agency for Railways (ERA), the European Commission Directorate-General for Mobility and Transport, and leading European railway organizations, the workshop featured twenty-four presentations on 'The Development of Rail Safety and Interoperability in the Mirror of the 4th Railway Package.' Our Head of System Pillar presented a paper on the development of the Single European Railway Area (SERA), contributing to discussions on the future of rail safety and interoperability in Europe.

ALICE Logistics Innovation Summit, 7 November 2024, online

On 7 November 2024, our Executive Director participated in the ALICE Logistics Innovation Summit 2024 in Brussels, contributing to the session 'The Role of Research and Innovation in Freight Transport and Logistics Twin Transition'. He discussed key actions to enhance rail freight competitiveness and presented the main findings of the Net-Zero Rail Freight Logistics study.

6th European Startup Prize for Mobility, 13 November 2024, Monaco

On 13 November, our Executive Director attended the opening ceremony of the 6th European Startup Prize in Monaco, marking the launch of the application process for this year's competition. The event brought together key stakeholders in clean transport from across Europe and Horizon Europe-associated countries to support and recognise innovative mobility solutions.

The European Startup Prize for Mobility honoured the ten best startups with access to an acceleration and investment programme, along with funding opportunities. Special prizes were awarded in categories such as UkrainianTech, River Mobility, Shared Mobility, Scale-Ups, and Female Entrepreneurship. As a partner of the initiative, Europe's Rail presented a dedicated special prize for rail mobility, reinforcing its commitment to fostering innovation in sustainable transport.

Working Party on Rail Transport by UNECE ,14 November in Geneva, Switzerland

Europe's Rail participated in the Working Party on Rail Transport organised by UNECE on 14 November in Geneva, Switzerland.

The discussion focused on innovation in rail transport, with an emphasis on best practices that could enhance the competitiveness of railways. The role of Europe's Rail in supporting the achievement of the European Commission's sustainable development goals was also highlighted during the session.

European Hydrogen Week, 18-22 November, Brussels, Belgium

The European Hydrogen Week took place from 18-22 November in Brussels, Belgium. The European Commission and the Clean Hydrogen Partnership organised a week of exhibitions and conferences, bringing together stakeholders from various hydrogen sectors.

Our Executive Director participated in a session on 'Hydrogen for Mobility and Synergies with End-Use Sectors', contributing to discussions on the role of hydrogen in enhancing mobility and its integration with other sectors.

Global FRMCS Conference, 19-20 November, Paris, France

Our Executive Director delivered the opening speech, highlighting Europe's Rail's commitment to advancing train modernisation and improving security, punctuality, services, and capacity. Our Senior Programme Manager discussed the support provided by the European Commission for the development of the Future Railway Mobile Communication System (FRMCS).

Europe's Rail General Assembly, 21-22 November, Online

On 21-22 November, Europe's Rail hosted its General Assembly online, providing an opportunity to reflect on the overall direction of the Joint Undertaking's activities. The event highlighted rail's crucial role in shaping a sustainable, carbon-neutral mobility and transport system while fostering an open discussion on the progress of the Master Plan implementation.

Following the opening remarks by the Director General for Mobility and Transport, the session explored operational reports, including updates on ongoing activities within the Innovation and System Pillars. A hands-on session also guided participants on how to actively engage in Europe's Rail initiatives, reinforcing collaboration and industry involvement.

Rail Live, 26-27 November 2024, Zaragoza, Spain

Europe's Rail participated in Rail Live 2024 on 26-27 November in Zaragoza, Spain, contributing to key discussions on digital transformation and innovation in rail. On 26 November, our Senior Programme Manager joined a panel on 'The Future of Satellite-Based Train Control', addressing interoperability challenges, regulatory considerations, and the advantages of integrating satellite technology into control systems. Later that day, our Programme Manager and Seconded National Expert took part in a discussion on 'Ensuring a Seamless Transition to FRMCS', focusing on collaboration to overcome implementation challenges and its impact on rail safety and efficiency. Simultaneously, our Head of System Pillar joined a panel exploring the balance between digital infrastructure innovations and legacy systems, highlighting strategies for optimising and retrofitting existing rail infrastructure.

On 27 November, our Executive Director participated in a panel on 'Delivering on Digital Transformation in Rail', discussing how to meet customer expectations through an effective innovation strategy. Later, our Senior Programme Manager contributed to a session on 'How Can Digital Transformation Help Freight Rail Attract Market Share?', examining the steps needed to boost rail freight's competitiveness against road and aviation. The event served as a platform for industry leaders to exchange insights on the future of railway digitalisation and innovation.

8th Danube Region Transport Days, 3 December, Ljubljana, Slovenia

On 3 December, the 8th Danube Region Transport Days took place in Ljubljana, Slovenia, focusing on the theme "Boosting Sustainable Transport and Connectivity".

Our Head of System Pillar attended the conference and participated in a panel discussion on the "Impact of Innovations and New Technologies on Rail". He presented on "Innovation, Harmonisation, and Deployment - Europe's Rail Joint Undertaking Modernising European Rail", highlighting the role of Europe's Rail in driving innovation and modernising the European rail system.

European Railway Research Advisory Council (ERRAC) Plenary Meeting, 4 December 2024, Paris, France

On 4 December, the European Railway Research Advisory Council (ERRAC) held its plenary meeting in Paris, France.

Our Executive Director attended the plenary meeting and delivered a keynote speech on "Delivering, Implementing, and Preparing the Future." ERRAC, a European Technology Platform (ETP), serves as a unified body to help revitalize the EU's rail sector and enhance its competitiveness.

Partnership Stakeholder event, 4-5 December, Brussels Belgium

EU-Rail actively participated to the Partnership Stakeholder events organised by DG RTD in Brussels on 4th and 5th December, advocating for the JUs common position and contributing in a working group focused on identifying the added value of partnerships and way forward jointly with two Member States representatives, one European Commission officer from DG Connect, one other Joint Undertaking (SNS) and one representative from the private automotive sector.

Workshop with Governing Board members on the future of the JU, 10 December, Brussels, Belgium and online

On December 10, EU-Rail organised a dedicated workshop on the future of the Programme with the members of its governing board, fostering a creative environment in the art-of-hosting participatory leadership. Almost 100% of governing board members attended the brainstorming day which led to conclusions used as the basis for the white paper on the future of the JU.

Global Tourism Forum Annual Meeting 2024, 10 December, Brussels, Belgium

Our Executive Director participated as a speaker in a session on 'Sustainable Infrastructure and Inclusive Practices' at this year's Global Tourism Forum Annual Meeting in Brussels, Belgium.

The session highlighted key initiatives transforming European transport, including the European Commission's plans to connect capitals and major cities via high-speed trains. Collaborations with the SESAR 3 Joint Undertaking to integrate air and rail traffic management for seamless travel were discussed, along with the role of Automated Train Operations in enabling energy-efficient rail journeys.

Communication statistics in 2024

Website User statistics

JU's website was visited by 205.441 unique visitors in 2024, which is a 29.6% increase compared to 144,645 unique visits in 2023. Most visitors (128,396) were based in Europe, followed by Asia (14,545) and North America (7,991). The largest number of visitors by country were based in Belgium, followed by Germany, Spain and Ireland. JU's website was mostly visited by people using a personal computer (162,381 visitors), second most popular device being smartphone (30,252 visitors). Average time spent on the JU website in 2024 was 2,41 minutes.

Newsletter

The 2024 editions continued to include more project results with a significant decrease in the average number of articles per newsletter to 22 (down from 29 compared to 2023). The reason being that in 2024 a higher emphasis was placed in grouping project news together and cutting down the length of the newsletter to improve readability. 2024 saw an increase in news coming from the Europe's Rail System Pillar, as more activities and outcomes were presented. A special edition of the newsletter was released in September 2024 dedicated to the Europe's Rail participation at InnoTrans 2024.

The readership of the JU newsletter has increased from 2,105 at the end of 2023 to 2,848 at the end of 2024. Various factors have fed into the growth of the audience including JU's participation to numerous events, more promotion of the newsletter by staff through their meetings and networks, and increased promotion of the newsletter and its individual articles on JU's corporate social media, the inclusion of more project news and deliverables stemming from the Europe's Rail programme.

Social media

Generally, the JU's social channels are used to engage with the rail community and other stakeholders, including the end users. In 2023 the EU-Rail Communication Team continued to produce more in-depth content on its LinkedIn account. Such content was well-received by the audience as it consists of mostly technical stakeholders and engineers. During 2024 EU-Rail has increased efforts in communicating with the projects and getting regular updated on their news in order to spread the word through social media.

The audiences JU targets on social media depend on the channels. While on X the JU is followed by a wide audience with different backgrounds, LinkedIn attracts a more specialised community interested rather in technical details and longer in-depth articles. JU's Communication Team creates different content in order to tailor the message to these different audiences. On X the JU shares daily events, short articles and posts illustrated with images and videos. On LinkedIn, however, the audience expects longer, more thought-provoking material including technical details about our innovations. In 2024 LinkedIn was the most viewed social media channel of EU-Rail.

At the end of 2024 the Europe's Rail LinkedIn account had 14,497 followers. On the other hand, JU's X account had 4.878 followers. While our overall engagement across social media platforms has remained strong, we have observed a slight decrease in our follower count on X. This trend aligns with broader shifts in user behaviour, as some audiences migrate to other platforms. We continue to monitor these developments and adapt our strategy accordingly to ensure effective outreach.

Throughout 2024, the JU has continued putting more effort into long-term social media planning to make sure that all relevant news is promoted through EU-Rail's social media platforms in a timely and effective manner. The JU also focused in 2024 on engaging more intensively with other relevant stakeholders on social media (DG MOVE, DG RTD, CINEA and other EU-institutions; Members and key associations) that helped to support the dissemination of JU messages and vice-versa.

Just like in previous years, in 2024, JU also had at the heart of its strategy the promotion of the JU project results through its social media channels. Thanks to the collection tool developed by the JU, projects are able to directly propose content for organic or re-shared posts. The projects are encouraged to send content directly to the Communication Team to ensure it is promoted across the social media channels in a timely manner. In 2024 the Communication Team launched the pilot phase of the dedicated EU Survey tools which is being used for collecting content from the projects for publication. The Communication Team received 130 submission through the tool in 2024.

Press

The JU published seven press releases in 2024, covering the JU's participation to Connecting Europe Days 2024, the landmark DAC event of the Connecting Europe Days 2024, the launch of the Women in Rail Awards 2024, the Call for Proposals 2023 results, the appointment of a new Executive Director, the participation to InnoTrans 2024, and the results of the Women in Rail Awards.

ANNEX D: Patents from projects

Project Number	Project Acronym	Project Call Id	Number Of CR Patents
777576	ETALON	H2020-S2RJU-OC-2017	4

ANNEX E: Scoreboard of Horizon 2020 (H2020) legacy KPIs

TABLE I - Horizon 2020 Key Performance Indicators[85] common to all JUs

	Correspondence to general Annex 1	Key Performance Indicator	Definition/Responding to question	Type of data required	Data to be provided by	Baseline at the start of H2020 (latest available)
INDUSTRIAL LEADERSHIP	12	SME - Share of participating SMEs introducing innovations new to the company or the market (covering the period of the project plus three years);	Based on Community Innovation Survey (?). Number and % of participating SMEs that have introduced innovations to the company or to the market	Number of SMEs that have introduced innovations;	H2020 beneficiaries through project reporting	N/A [new approach under H2020]
	13	SME - Growth and job creation in participating SMEs	Turnover of company, number of employees	Turnover of company, number of employees;	H2020 beneficiaries through project reporting	N/A [new approach under H2020]
SOCIETAL CHALENGES	14	Publications in peer-reviewed high impact journals in the area of the JU	The percentage of papers published in the top 10% impact ranked journals by subject category	Publications from relevant funded projects (DOI: Digital Object Identifiers); Journal impact benchmark (ranking) data to be collected by commercially available bibliometric databases.	H2020 beneficiaries through project reporting; Responsible Directorate/Service (via access to appropriate bibliometric databases)	N/A [new approach under H2020]

[85] Based on Annex II to Council Decision 2013/743/EU

	Correspondence to general Annex 1	Key Performance Indicator	Definition/Responding to question	Type of data required	Data to be provided by	Baseline at the start of H2020 (latest available)	Target at the end of H2020	Automated	Result 2024
	15	Patent applications and patents awarded in the area of the JU	Number of patent applications by theme; Number of awarded patents by theme	Patent application number	H2020 beneficiaries through project reporting; Responsible Directorate/Service (via worldwide search engines such as ESPACENET, WOPI)	N/A [new approach under H2020]	On average, 2 per €10 million fu–ding (2014 - 2020) RTD A6	Yes	4
	16	Number of prototypes testing activities and clinical trials	Number of prototypes, testing (feasibility/demo) activities, clinical trials	Reports on prototypes, and testing activities, clinical trials	H2020 beneficiaries through project reporting	N/A [new approach under H2020]	[To be developed on the basis of first Horizon 2020 results]	Yes	817
	17	Number of joint public-private publications in projects	Number and share of joint public-private publications out of all relevant publications	Properly flagged publications data (DOI) from relevant funded projects	H2020 beneficiaries through project reporting; Responsible Directorate/Service (via DOI and manual data input-flags)	N/A [new approach under H2020]	[To be developed on the basis of first Horizon 2020 results]	Yes	59
	18*	New products, processes, and methods launched into the market	Number of projects with new innovative products, processes, instruments, methods, technologies	Project count and drop-down list allowing to choose the type processes, products, instruments, methods, technologies	H2020 beneficiaries through project reporting	N/A [new approach under H2020]	[To be developed on the basis of first Horizon 2020 results]	Yes	72

	Correspondence to general Annex 1	Key Performance Indicator	Definition/Responding to question	Type of data required	Data to be provided by	Baseline at the start of H2020 (latest available)	Target at the end of H2020	Automated	Result 2024
EVALUATION	N/A	Time to inform (average time in days) all applicants of the outcome of the evaluation of their application from the final date for submission of completed proposals	To provide applicants with high quality and timely evaluation results and feedback after each evaluation step by implementing and monitoring a high scientific level peer-reviewed process	Number of days (average)	Joint Undertaking	H2020		Yes	all calls (TTI): average 94 / Maximum 176 2024 calls: N/A**
	N/A	Redress after evaluations	To provide applicants with high quality and timely evaluation results and feedback after each evaluation step by implementing and monitoring a high scientific level peer-reviewed process	Number of redresses requested	Joint Undertaking	H2020			N/A**
GRANTS	N/A	Time to grant (average) measured from call deadline to signature of grants	To minimise the duration of the granting process aiming at ensuring a prompt implementation of the Grant Agreements through a simple and transparent grant preparation process	Average in days under H2020 TTG < 270 days (as % of GAs signed)	Joint Undertaking	H2020		Yes	all calls (TTG): average 191 2024 calls: N/A**
	N/A	Time for signing grant agreements from the date of informing successful applicants (average values)		Average in days under H2020	Joint Undertaking	H2020		Yes	all calls (TTS): average 94 2024 calls: N/A**

	Correspondence to general Annex 1	Key Performance Indicator	Definition/Responding to question	Type of data required	Data to be provided by	Baseline at the start of H2020 (latest available)	Target at the end of H2020	Automated	Result 2024
AUDITS	N/A	Error rate	RepER: Error rate detected in a JU-specific representative sample of DG RTD's Common Audit Service (CAS) ex-post audits ResER: residual error showing how much error left as a result of the implementation of audit conclusions and errors corrected	Representative error in %; residual error in %	CAS	H2020	The residual error rate should be within the threshold of 2%	No	representative error of 1,93% for the JU (weighted average); residual error of 0,67% for the JU (weighted average)
	N/A	Implementation of ex-post audit results	Number of ex-post audit results implemented	Number of cases implemented; in total €million; Number of cases implemented/total cases	Joint Undertaking	H2020		No	104 implemented cases, EUR 433.267,47 96,3% of total cases

	Correspondence to general Annex 1	Key Performance Indicator	Definition/Responding to question	Type of data required	Data to be provided by	Baseline at the start of H2020 (latest available)	Target at the end of H2020	Automated	Result 2024
PAYMENTS	N/A	Time to pay (% made on time) -pre-financing - interim payment -final payment	To optimize the payments circuits, both operational and administrative, including payments to experts	Average number of days for Grants pre-financing, interim payments and final payments; Average number of days for administrative payments;	Joint Undertaking	H2020	-pre-financing (30 days) - interim payment (90 days) -final payment (90days)	Yes	Operational: Pre-financing: N/A Interim/final: 35 (95%) Average number of days: 55 Administrative: Pre-financing: 5 (100%) Average number of days: 23 Interim/final: 774 (96,4%) Average number of days: 18
HR	N/A	Occupancy rate (%)		post filled in %, composition of the statutory JU staff and seconded national experts (SNEs)[86]	Joint Undertaking	H2020			91% (vacancy rate 9%)

[86] Additional indicators can be proposed/discussed with R.1 and/or DG HR

	Correspondence to general Annex 1	Key Performance Indicator	Definition/Responding to question	Type of data required	Data to be provided by	Baseline at the start of H2020 (latest available)	Target at the end of H2020	Automated	Result 2024
JU EFFICIENCY	N/A	Budget implementation/execution: 1. % CA to total budget 2. % PA to total budget	Realistic yearly budget proposal, possibility to monitor and report on its execution, both in commitment (CA) and payments (PA), in line with sound financial management principle	% of CA and PA	Joint Undertaking	H2020	100% in CA and 90% in PA	Yes	CA: 99,9% PA: 87,9%
	N/A	Administrative Budget: Number and % of total of late payments	Realistic yearly budget proposal, possibility to monitor and report on its execution in line with sound financial management principle	Number of delayed payments % of delayed payments (of the total)	Joint Undertaking		H2020	Yes	30 late payments 4%

NOTES:

18*: This indicator is not a legally compulsory one, but it covers several additional specific indicators requested for more societal challenges by the services in charge.

**: In 2024, there were no new EU-Rail calls for proposals under H2020. Statistics related to the 2024 EU-Rail call pertaining to the Horizon Europe Programme are provided in Section 1.5 of this CAAR.

TABLE II - Indicators for monitoring H2020 Cross-Cutting Issues[87] common to all JTI JUs

Correspondence to the general Annex 2	Cross-cutting issue	Definition/Responding to question	Type of data required	Data to be provided by	Data to be provided in/to	Direct contribution to ERA	Automated	Result 2024
2	Widening the participation	2.1 Total number of participations by EU-28 Member State	Nationality of H2020 applicants & beneficiaries (number of countries)	H2020 applicants & beneficiaries at the submission and grant agreement signature stage	JU AAR RTD Monitoring Report	Yes	Yes	N/A**
		2.2 Total amount of EU financial contribution by EU-28 Member State (EUR millions)	Nationality of H2020 beneficiaries and corresponding EU financial contribution	H2020 beneficiaries at grant agreement signature stage	JU AAR RTD Monitoring Report	Yes	Yes	N/A**
N/A		Total number of participations by Associated Countries	Nationality of H2020 applicants & beneficiaries (number of countries)	H2020 applicants & beneficiaries at the submission and grant agreement signature stage	JU AAR RTD Monitoring Report	Yes	Yes	N/A**
N/A		Total amount of EU financial contribution by Associated Country (EUR millions)	Nationality of H2020 beneficiaries and corresponding EU financial contribution	H2020 beneficiaries at grant agreement signature stage	JU AAR RTD Monitoring Report	Yes	Yes	N/A**
3	SMEs participation	3.1 Share of EU financial contribution going to SMEs (Enabling & industrial tech and Part III of Horizon 2020)	Number of H2020 beneficiaries flagged as SME; % of EU contribution going to beneficiaries flagged as SME	H2020 beneficiaries at grant agreement signature stage	JU AAR RTD Monitoring Report		Yes	N/A**

[87] Based on Annex III to Council Decision 2013/743/EU

Correspondence to the general Annex 2	Cross-cutting issue	Definition/Responding to question	Type of data required	Data to be provided by	Data to be provided in/to	Direct contribution to ERA	Automated	Result 2024
		6.1 Percentage of women participants in H2020 projects	Gender composition of participants in H2020 projects	H2020 Beneficiaries throughout project reporting		Yes	Yes	N/A**
		6.2 Percentage of women project coordinators in H2020	Gender of MSC fellows, ERC principle investigators and scientific coordinators in other H2020 activities	H2020 beneficiaries at the grant agreement signature stage		Yes	Yes	N/A**
6	Gender	6.3 Percentage of women in EC advisory groups, expert groups, evaluation panels, individual experts, etc.	Gender composition of memberships in advisory groups, panels, etc.	Compiled by Responsible Directorate/ Service /Joint Undertaking based on existing administrative data made available by the CSC		Yes	No	EU-Rail Governing Board: 14,8% of representatives are female among the GB members, 10,7% among all members including alternates - Observers in the GB on behalf of the JU States' Representatives Group: The single observer for this body is male - Observers in the GB on behalf of the JU Scientific Steering Group: 100% of members are female (the single observer for this body) - Observers in the GB on behalf of the European Union Agency for Railways: 66,7% of representatives are female

Correspondence to the general Annex 2	Cross-cutting issue	Definition/Responding to question	Type of data required	Data to be provided by	Data to be provided in/to	Direct contribution to ERA	Automated	Result 2024
								- Observers in the GB on behalf of The European Rail Research Advisory Council's (ERRAC): 50% of representatives are female
7	International cooperation	7.1 Share of third-country participants in Horizon 2020	Nationality of H2020 beneficiaries	H2020 beneficiaries at the grant agreement signature stage	JU AAR RTD Monitoring Report	No	Yes	N/A**
		7.2 Percentage of EU financial contribution attributed to third country participants	Nationality of H2020 beneficiaries and corresponding EU financial contribution	H2020 beneficiaries at the grant agreement signature stage	JU AAR RTD Monitoring Report	No	Yes	N/A**
9	Bridging from discovery to market[88]	9.1 Share of projects and EU financial contribution allocated to Innovation Actions (IAs)	Number of IA projects	Project Office – at GA signature stage he/she will be required to flag in SyGMa. Responsible Directorate/Service (WP coordinator)/Joint Undertaking - via tool CCM2	JU AAR RTD Monitoring Report		Yes	N/A**
		9.2 Within the innovation actions, share of EU financial contribution focused on demonstration and first-of-a-kind activities	Topics properly flagged in the WP; follow-up at grant level	Responsible Directorate/Service (WP coordinator)/Joint Undertaking - via tool CCM2	JU AAR RTD Monitoring Report		Yes	N/A**

[88] The indicator 9.2 initially intended to monitor the Digital Agenda (its applicability could be limited)

Correspondence to the general Annex 2	Cross-cutting issue	Definition/Responding to question	Type of data required	Data to be provided by	Data to be provided in/to	Direct contribution to ERA	Automated	Result 2024
N/A		10 Scale of impact of projects (High Technology Readiness Level)	Number of projects addressing TRL[89] between 4-6 and 5-7	Joint Undertaking	JU AAR RTD Monitoring Report		No	N/A**
11	Private sector participation	11.1 Percentage of H2020 beneficiaries from the private for-profit sector	Number of and % of the total H2020 beneficiaries classified by type of activity and legal status	H2020 beneficiaries at grant agreement signature stage	JU AAR RTD Monitoring Report		Yes	N/A**
		11.2 Share of EU financial contribution going to private for-profit entities (Enabling & industrial tech and Part III of Horizon 2020)	H2020 beneficiaries classified by type of activity; corresponding EU contribution	H2020 beneficiaries at grant agreement signature stage	JU AAR RTD Monitoring Report		Yes	N/A**
12	Funding for PPPs	12.1 EU financial contribution for PPP (Art 187)	EU contribution to PPP (Art 187)	Responsible Directorate/Service	JU AAR RTD Monitoring Rep ort		Yes	S2R: EUR 0,5M EU-Rail: EUR 73,2M
		12.2 PPPs leverage: total amount of funds leveraged through Art. 187 initiatives, including additional activities, divided by the EU contribution	Total funding made by private actors involved in PPPs - in-kind contribution already committed by private members in project selected for funding - additional activities (i.e. research expenditures/investment of	Joint Undertaking Services	JU AAR RTD Monitoring Report			108% 155%

[89] TRL: Technology Readiness Level

Correspondence to the general Annex 2	Cross-cutting issue	Definition/Responding to question	Type of data required	Data to be provided by	Data to be provided in/to	Direct contribution to ERA	Automated	Result 2024
			industry in the sector, compared to previous year)					
13	Communication and dissemination	13.3 Dissemination and outreach activities other than peer-reviewed publications - [Conferences, workshops, press releases, publications, flyers, exhibitions, trainings, social media, websites, communication campaigns (e.g. radio, TV)]	A drop-down list allows to choose the type of dissemination activity. Number of events, funding amount and number of persons reached thanks to the dissemination activities	H2020 Beneficiaries throughout project reporting	JU AAR RTD Monitoring Report	Yes	Yes	6.432 Dissemination and outreach activities other than peer-reviewed publications People reached: 2.804.210
14	Participation patterns of independent experts	14.2 Proposal evaluators by country	Nationality of proposal evaluators	Responsible Directorate /Service/Joint Undertaking in charge with the management of proposal evaluation			Yes	N/A**
		14.3 Proposal evaluators by organisations' type of activity	Type of activity o' evaluators' organisations	Responsible Directorate /Service/Joint Undertaking in charge with the management of proposal evaluation			Yes	N/A**

Correspondence to the general Annex 2	Cross-cutting issue	Definition/Responding to question	Type of data required	Data to be provided by	Data to be provided in/to	Direct contribution to ERA	Automated	Result 2024
N/A	Participation of RTOs and Universities	Participation of RTOs[90] and Universities in PPPs (Art 187 initiatives)	Number of participations of RTOs to funded projects and % of the total Number of participations of Universities to funded projects and % of the total % of budget allocated to RTOs and to Universities	H2020 beneficiaries at the grant agreement signature stage	JU AAR RTD Monitoring Report	Yes	Yes	N/A**
N/A	Ethics	The objective is ensuring that research projects funded are compliant with provisions on ethics	% of proposals not granted because non-compliance with ethical rules/proposals invited do grant (target 0%); time to ethics clearance (target 45 days)[91]	Responsible Directorate /Service/Joint Undertaking	JU AAR RTD Monitoring Report			N/A**

NOTES:

*H2020–applicants - all those who submitted H2020 proposals

*H2020 beneficiaries - all those who have signed a H2020 Grant Agreement

[90] RTO: Research and Technology Organisation
[91] Data relates to pre-granting ethics review. This time span runs in parallel to granting process.

**: In 2024, there were no new EU-Rail calls for proposals under H2020. Statistics related to the 2024 EU-Rail call pertaining to the Horizon Europe Programme are provided in Section 1.5 of this CAAR.

TABLE III - Key Performance Indicators specific for EU-Rail

#	Key Performance Indicator	Objective	Data to be provided by	Baseline at the start of H2020	Target at the end of H2020	Automated	Result 2024
EU-Rail							
1	% reduction in the costs of developing, maintaining, operating and renewing infrastructure and rolling stock and increase in energy efficiency compared to "Stat"-of-the-art"	Reduce the life-cycle cost of the railway transport system	JU	"State-of-the-art" 2014	> 50 %	No	See Table IV for S2R programme data
2	% increase the capacity of railway segments to meet increased demand for passenger and freight railway services compared to "Stat"-of-the-art" 2014	Enhance the capacity of the railway transport system	JU	"State-of-the-art" 2014	100%	No	See Table IV for S2R programme data
3	% decrease in unreliability and late arrivals compared to "State-of-the-art" 2014	Increase in the quality of rail services	JU	"State-of-the-art" 2014	> 50%	No	See Table IV for S2R programme data
4	Reduce noise emissions and vibrations linked to rolling stock and respectively infrastructure compared to "State-of-the-art" 2014	Reduce the negative externalities linked to railway transport	JU	"State-of-the-art" 2014	> 3 - 10 dBA	No	No updated values in 2024, results in 2023
5	Addressing open points in TSIs, compared to "State-of-the-art" 2014	Enhance interoperability of the railway system	JU	"State-of-the-art" 2014		No	- No updated values in 2024, results in 2023

#	Key Performance Indicator	Objective	Data to be provided by	Baseline at the start of H2020	Target at the end of H2020	Automated	Result 2024
6	Number of Integrated Technology Demonstrators (ITDs) and System Platform Demonstrations (SPD)	Improve market uptake of innovative railway solutions through large-scale demonstration activities	JU	Multi-Annual Action Plan	4 SPD	No	No updated values in 2024, results in 2023
7	Share of the fund allocated to the different Innovation Programmes and to cross-cutting themes	Ensure that funding covers the railway system as a whole	JU	N/A	> 80%	No	100% of the operational funding
8	Percentage of topics resulting in signature of GA	Ensure a sufficiently high call topics success rate	JU	N/A	> 90%	Yes	N/A*
9	% of resources consumption versus plan (members only)	WP execution–by members - resources	JU	N/A	> 80%	Yes	-
10	% of deliverables available versus plan (members only)	WP execution–by members - deliverables	JU	N/A	> 80%	No	91,8% - 2015-2020 71,3% - 2020 72,7% - 2021 57% - 2022** 89% - 2023 100% - 2024

NOTES:

*: In 2024, there were no new EU-Rail calls for proposals under H2020. Statistics related to the 2024 EU-Rail call pertaining to the Horizon Europe Programme are provided in Section 1.5 of this CAAR.

**: The KPI value for 2022 was affected by the fact that several amendments to the Grant Agreements proposed by the members were in the process of approval by the cut-off date, and consequently, until the amendments are approved, the concerned deliverables are formally considered delayed.

TABLE IV – Release 5 - of the Key Performance Indicators of the Shift2Rail Programme

SPD	LCC	Capacity	Punctuality
Target	-50%	+100%	+50%
High Speed	-20% (-21% / -14% / -15% / -18%)	58% (58% / 68% / 69% / 74%)	39% (35% / 35% / 29% / 19%)
Regional	-29% (-30% / -21% / -21% / -24%)	90% (90% / 62% / 57% / 49%)	55% (53% / 52% / 51% / 15%)
Metro	-16% (-16% / -15% / -16% / -18%)	21% (21% / 27% / 23% / 28%)	n/a (n/a / n/a / n/a / 19%)
Freight	-41% (-40% / -39% / -39% / -40%)	96% (87% / 111% / 42-114% / 91%)	57% (57% / 57% / 78% / 71%)

release 4.0 release 3.0 release 2.0 release 1.0

One of the objectives of the Shift2Rail Joint Undertaking defined in its regulation is to seek developing, integrating, demonstrating and validating innovative technologies and solutions that uphold the strictest safety standards and the value of which can be measured against, inter alia, 3 quantitative Key Performance Indicators (KPIs). The targets defined are the following: reduction of LCC by 50%, improving the reliability & punctuality by 50% and doubling the capacity.

As the railway is a very interlinked and complex system, it is required to have specific tools and methods to evaluate the effect of technological developments. This question is highly relevant for Shift2Rail as the technologies, which are developed, are to be evaluated with respect to four scenarios called System Platform Demonstrators (SPDs). Hence an approach of estimating the above mentioned KPIs applied on the four generic SPDs based on the market segments high-speed rail, regional rail, metro and freight rail[92] has been applied which were defined in the S2R Master Plan[93].

As some of the Shift2Rail technologies (e.g. Innovation Programme on IT Solutions for Attractive Railway Services) are targeting to increase modal share of rail within the transport sectors by satisfying the customer's travel experience, those innovations cannot be taken directly into account in the three quantitative KPIs,

92 IMPACT-1 – D4.1 "Reference Scenario" – 2018, Issue 1
93 Shift2Rail - Shift2Rail Master Plan (MP) – 2015

only via an increased load factor. Therefore, a dedicated model on the improvement of the attractiveness of the rail system is developed independent from the model discussed here (see also explanations to "demand effect").

In 2022, the Release 5 of the KPI model was published. After Release 4, the model was frozen and in 2022, the collection of updated improvement values and accuracy levels was carried out.

The Accuracy of the improvement data was developed for Release 3 to increase the robustness of the model. In Release 4 and 5, the reported numbers of data set linked to the accuracy level and the values of the accuracy level increased.

Key Performance Indicators – KPI

The KPI Life-Cycle-Cost (LCC) is defined as the cost for the railway undertaking over the lifespan of the systems. Hence, they are the investment cost, operative cost like maintenance, labour or energy cost and, where applicable, the dismantling cost.

The KPI Capacity is defined as the maximum possible capacity, which is the maximum number of transportable passengers in one peak hour for the passenger transport scenarios and the maximum of tonne-kilometres in 24 hours for freight.

The KPI Reliability and Punctuality is measured as a 50% decrease of late arrivals mainly caused by unreliability of technologies.

System Platform Demonstrators – SPDs

The reference scenarios (state of the art technologies in 2013) described in the deliverable D4.1 "Reference Scenarios" of IMPACT-1 and were further developed in IMPACT-2. The data for these scenarios were collected from various sources whereas usually there could only one source for each certain parameter be found. The coherence check is scheduled for the next iteration of the model.

Further there are aspects for the four different market segments of the SPDs, which need to be kept in mind, when reviewing the result table. Those aspects are due to the inherent structure and specificities of the different market segments:

For the High-Speed passenger transport (SPD1), relatively new or constantly upgraded vehicles and lines are taken into account, which are more or less best of class in Europe. Therefore, it is on the one hand a much-elaborated basis to start from and on the other hand it can be assumed that effects at less developed railways will show much higher results.

The main relevant KPIs for typically Regional Rail (SPD2) lines are LCC and punctuality. Hence the challenge is here to provide a punctual service at lower cost.

Concerning Metro Rail (SPD3), there are few activities dedicated directly on Metro in direct relation to the specific S2R JU objectives in the short term. Therefore, the results for Metro are mainly based on positive effects of the innovations developed for High Speed or Regional trains as e.g. reduction of energy consumption or improved maintenance. They are not optimised for this special form of rail transport but can help to reduce LCC and improve capacity.

Because SPD4, Freight rail, is not focussing on passenger transport, but freight transport, it differs in some definitions and focus points from the other three SPDs. Further the modelling has not only to consider technological improvements, but also operational optimisation for rail freight transport. Moreover, as generally the introduction of innovations in freight rail operation takes more time than in passenger transport, the technology level in execution is quite moderate. Taking both into account, the more legacy basis to start from and the technological and operational effects, the achievable benefits are much higher than for the other three SPDs.

Furthermore, some innovations cannot show their full potential, because there is only one scenario per market segment. Those scenarios are optimised to show the majority of positive effects but cannot be set to show every effect of every Shift2Rail innovation.

Demand effect

As already explained in the background, large parts of positive effects especially for the passenger transport (SPD1-3) are not adequately measurable through LCC, capacity and punctuality, e.g. new IT solutions (IP4), effects of other innovations such as noise mitigation, customer-oriented services and better quality, increased comfort for the customers, better governance etc. Those will be included in the attractiveness model. Therefore, the increase of demand is not considered in the results for the passenger SPDs, yet, meaning that for the first results there is no change in the load factor and therefore in the demand included. For the freight SPD, a demand increase could already be considered and therefore also its positive effect on the contribution margin.

ANNEX F: HORIZON EUROPE KPIs

Scoreboard of Horizon Europe common Key Impact Pathway Indicators (KIPs)*

Key Impact Pathway**	Short-term	Medium-term	Longer-term	Detail per action or globally for 2024
Towards scientific impact				
1-Creating high-quality new knowledge	Publications - Number of peer-reviewed scientific publications resulting from the Programme	Citations - Field-Weighted Citation Index of peer-reviewed Publications resulting from the Programme	World-class science - Number and share of peer-reviewed publications resulting from the projects funded by the Programme that are core contribution to scientific fields	1
2-Strengthening human capital in R&I	Skills - Number of researchers involved in upskilling (training, mentoring/coaching, mobility and access to R&I infrastructures) activities in projects funded by the Programme	Careers - Number and share of upskilled researchers involved in the Programme with increased individual impact in their R&I field	Working conditions - Number and share of upskilled researchers involved in the Programme with improved working conditions, including researchers' salaries	385
3-Fostering diffusion of knowledge and open science	Shared knowledge Share of research outputs (open data/publication/software etc.) resulting from the Programme shared through open knowledge infrastructures	Knowledge diffusion -Share of open access research outputs resulting from the Programme actively used/cited	New collaborations - Share of Programme beneficiaries which have developed new transdisciplinary/trans sectoral collaborations with users of their open access research outputs resulting from the Programme	2 OA publications 0 OA datasets 0 OA software 100% shared knowledge
Towards societal impact				
4-Addressing Union policy priorities and global challenges through R&I	Results - Number and share of results aimed at addressing identified Union policy priorities and global challenges (including SDGs) (multidimensional: for each identified priority) Including: Number and share of climate-relevant results aimed at delivering on the Union's commitment under the Paris Agreement	Solutions - Number and share of innovations and research outcomes addressing identified Union policy priorities and global challenges (including SDGs) (multidimensional: for each identified priority) Including: Number and share of climate-relevant innovations and research outcomes	Benefits - Aggregated estimated effects from use/exploitation of results funded by the Programme on tackling identified Union policy priorities and global challenges (including SDGs), including contribution to the policy and law-making cycle (such as norms and standards) (multidimensional: for each identified priority) Including: Aggregated estimated effects from use/exploitation of climate-relevant results	1 policy publications 0 policy results 0 policy IPRs 100% EU Policy Priority results

		delivering on Union's commitment under the Paris Agreement	funded by the Programme on delivering on the Union's commitment under the Paris Agreement including contribution to the policy and law-making cycle (such as norms and standards)	
5-Delivering benefits and impact through R&I missions	R&I mission results - Results in specific R&I missions (multidimensional: for each identified mission)	R&I mission outcomes - Outcomes in specific R&I missions (multidimensional: for each identified mission)	R&I mission targets met - Targets achieved in specific R&I missions (multidimensional: for each identified mission)	No data available for 2024
6-Strengthening the uptake of R&I in society	Co-creation - Number and share of projects funded by the Programme where Union citizens and end-users contribute to the co-creation of R&I content	Engagement - Number and share of participating legal entities which have citizen and end-users engagement mechanisms in place after the end of projects funded by the Programme	Societal R&I uptake - Uptake and outreach of co-created scientific results and innovative solutions generated under the Programme	1 signed grant with citizen or end user engagement 7 projects with periodic report 14% grants with citizen or end user engagement
Towards technological / economic impact				
7-Generating innovation-based growth	Innovative results - Number of innovative products, processes or methods resulting from the Programme (by type of innovation) & Intellectual Property Rights (IPR) applications	Innovations - Number of innovations resulting from the projects funded by the Programme (by type of innovation) including from awarded IPRs	Economic growth - Creation, growth & market shares of companies having developed innovations in the Programme	No data available for 2024
8-Creating more and better jobs	Supported employment - Number of full time equivalent (FTE) jobs created, and jobs maintained in participating legal entities for the project funded by the Programme (by type of job)	Sustained employment - Increase of FTE jobs in participating legal entities following the project funded by the Programme (by type of job)	Total employment - Number of direct & indirect jobs created or maintained due to diffusion of results from the Programme (by type of job)	No data available for 2024

9-Leveraging investments in R&I	Co-investment - Amount of public & private investment mobilised with the initial investment from the Programme	Scaling-up - Amount of public & private investment mobilised to exploit or scale-up results from the Programme (including foreign direct investments)	Contribution to '3 % target' - Union progress towards 3 % GDP target due to the Programme	379.7M

** (based on Annex V to Regulation 2021/695/EU)*

*** NB: For some of those KIPs the data will not be available in the short or even medium term.*

Horizon Europe Partnership common Key Performance Indicators

Criterion addressed	Name of the Indicator	Baseline at the start of HE	Results for 2024	Target 2027
Additionality	Progress towards (financial and in-kind) contributions from partners other than the Union – i.e. committed vs. actual	N/A	EUR 81,7M IKAA certified for a total 171,1K signed	Total In kind contribution: EUR 576M Total financial contribution to the JU running costs: EUR 24M
Additionality / Synergies	Additional investments triggered by the EU contribution, including qualitative impacts related to additional activities	N/A	Over the course of the programme, EU-Rail members contribute with additional activities, including mobilisation of private investment and national/regional programmes. Expected according to IKAA Plan 2022-2024: 2024 = EUR 71,6,9M Estimated 2024 value of IKAA linked to JU objectives/KPIs - EUR 4,8M Estimated 2024 value of IKAA link to JU projects/topics - EUR 66,8iM	Target 2022-2024: EUR 150,5M
Directionality	Overall (public and private, in-kind and cash) investments mobilised towards EU priorities	0	EUR 21,7M funding in signed grants linked to the following EU priorities: - European Green Deal - Europe fit for digital age	EUR 600M

International visibility and positioning	International actors involved	0	9 entities from Associated countries and Third countries are participating in projects as associated partners (2 from Norway, 4 from Switzerland, 2 from the UK, and 1 from Turkey) By type: 1 public organization (11%), 2 research organizations (22%), 5 private for profit organizations (56%) and 1 other organizations (11%)	N/A
Transparency and openness	Share & type of stakeholders and countries invited/engaged	0	In general the entire rail value chain. In projects:366 beneficiaries (12 public organizations (3%), 56 higher or secondary education establishment (15%), 47 research organizations (13%), 229 private for profit organizations (63%) and 22 others(6%)) 27 countries (22 from EU, 4 associated countries and 1 third country) In the EU-Rail States' Representatives Group: 31 member states demonstrating interest (26 from EU and 5 associated countries)	N/A

Transparency and openness	No. and types of newcomer members in partnerships and their countries of origin (geographical coverage)	0		N/A

Organisation Name	Category	Countr
Administrador de Infraest	[PRV Other Industrial and/or profit Private organisation]	ES
Alstom Transport SA	[PRV Other Industrial and/or profit Private organisation]	FR
ANGELRAIL consortium le	[PRV Other Industrial and/or profit Private organisation]	IT
AŽD Praha s.r.o	[PRV Other Industrial and/or profit Private organisation]	CZ
Construcciones y Auxiliar	[PRV Other Industrial and/or profit Private organisation]	ES
Asociación Centro Tecnol	[RES Public research organisation (including international research organisation as well as private research organisation controlled by a public authority)]	ES
České dráhy, a.s.	[PRV Other Industrial and/or profit Private organisation]	CZ
Deutsche Bahn AG	[PRV Other Industrial and/or profit Private organisation]	DE
Deutsches Zentrum für Lu	[RES Public research organisation (including international research organisation as well as private research organisation controlled by a public authority)]	DE
European Smart Green Ra	[PRV Other Industrial and/or profit Private organisation] + [RES Public research organisation (including international research organisation as well as private research organisation controlled by a public authority)]	ES
Faiveley Transport SAS	[PRV Other Industrial and/or profit Private organisation]	FR
Ferrovie dello Stato Italiar	[PRV Other Industrial and/or profit Private organisation]	IT
Hitachi Rail STS S.p.A.	[PRV Other Industrial and/or profit Private organisation]	IT
INDRA SISTEMAS S.A & PATEI	[PRV Other Industrial and/or profit Private organisation]	ES
Jernbanedirektorate (Norv	[PRV Other Industrial and/or profit Private organisation]	NO
Knorr-Bremse Systems für	[PRV Other Industrial and/or profit Private organisation]	DE
Österreichische Bundesba	[PRV Other Industrial and/or profit Private organisation]	AT
Polskie Koleje Państwowe	[PRV Other Industrial and/or profit Private organisation]	PL
ProRail B.V. & NS Groep N.V.	[PRV Other Industrial and/or profit Private organisation]	NL
Siemens Mobility GmbH	[PRV Other Industrial and/or profit Private organisation]	DE
Société nationale SNCF, s	[PRV Other Industrial and/or profit Private organisation]	FR
Strukton Rail Nederland B	[PRV Other Industrial and/or profit Private organisation]	NL
THALES SIX GTS France SA	[PRV Other Industrial and/or profit Private organisation]	FR
Trafikverket	[PRV Other Industrial and/or profit Private organisation]	SE
voestalpine Railway Syste	[PRV Other Industrial and/or profit Private organisation]	AT

Transparency and openness	No. and types of newcomer beneficiaries in funded projects (in terms of types and countries of origin)	N/A	38 newcomers (34 EU & 4 non-EU) of which 7 are SMEs. PRC: 29 PUB: 2 REC: 2 OTH: 3 HES: 1	
Coherence and synergies	Number and type of coordinated and joint activities with other European Partnerships	0	4 back office arrangements (2 of them as leading and lead backup contracting authorising)	7 arrangements among JUs in accordance with Art. 13 of the SBA
Coherence and synergies	Number and type of coordinated and joint activities with other R&I Initiatives at EU /national/regional/sectorial level	0	Coordinated activities at EU level with national / sectorial R&I actions on the Digital Automated Couplers with the European DAC delivery Programme, enabled by EU-Rail. Rail system architecture coordinated in the System Pillar with national and sectorial input notably around signalling activities. Coordination also with Rail Net Europe on infrastructure capacity planning and R&I on traffic management.	N/A

			Synergy topic with SESAR JU for project FP1 – Travel Wise and with SNS JU for project FP2 – MORANE-2. Coordination with national activities following the State Representative Group indication of national projects: 14 countries (members of the State representatives group) provided their contributions on national R&I activities to EU-Rail, with 60 projects/programmes identified so far. By the end of 2024, the JU identified 17 synergy actions with some of these activities and their implementation was already ongoing.	
Coherence and synergies	Complementary and cumulative funding from other Union funds (Horizon Europe, National funding, ERDF, RRF, Other cohesion policy funds, CEF, DEP, LIFE, other)	0	Synergies with EU Missions – EUR 0,7M for Smart Cities (Contribution Agreement between the European Union, represented by the European Commission, and EU-Rail, with the objective to provide a financial contribution to finance the implementation of the action "Pilot project - IRS Smart Cities project: new railway station concept for green and socially inclusive smart cities") EUR 3M Joint topic call with SESAR EUR 1M Joint topic call with SNS	N/A
International visibility and positioning	Visibility of the partnership in national, European, international policy/industry cycles	0	• Published 10 newsletters • Published 7 press releases • Released 2 publications • Organised 4 events • Participated in 58 industry events	N/A

			• Average number of tweets per month was 30 • 4.878 twitter followers by the end of 2024 • 14.497 LinkedIn followers by the end of 2024 • 2.848 newsletter subscribers by the end of 2024 • 116 members in the general contact list (receiving the newsletter and mailshots) • 181 members in media list • 80 mentions in press articles • 31 project deliverables highlighted in the news section of the website • 205.441 unique visitors on the website • 40 articles produced by EU-Rail	

Scoreboard of Key Performance Indicators specific to EU-Rail

#	Impact areas	Key Performance Indicator	Objective	Baseline at the start of HE	Results of 2024	Target at the end of HE
1	Customer requirements	Accuracy in total planned travel time of passengers from improved matching between supply and demand, #	Increase availability and predictability of intermodal rail transport offer	State of art in 2020 (including results from S2R)	80%	75%
		Traffic planning certainty, #	Planning certainty, considering the demand forecast, is a key requirement for planning on time, reliable and efficient service delivery	State of art in 2020 (including results from S2R)	Between 50% and 65%	Between 65% and 80%[1]

		Handling/response time for intermodal freight offers and regional passenger services, mins	Improve overall customer experience, including growing intermodal freight transport and regional passenger services	State of art in 2020 (including results from S2R)	50%	At least 50%
2	Improved Capacity	Trains on the line per hour and direction, #	Increased frequency is a key element for improved capacity	State of art in 2020 (including results from S2R)	+10% to +15%	At least +10%[2]
		Reduction of total freight transport time, mins	Reduced freight transport time leading to better asset utilization and increased capacity	State of art in 2020 (including results from S2R)	Between 10% and 20%	20%
		Increased average freight train length in existing infrastructure limitations or higher loads, meters	Increased length directly leads to more available capacity	State of art in 2020 (including results from S2R)	Length up to 1.500m	Up to 1.500m
3	Reduced Costs	Overall OPEX and CAPEX costs of regional lines, incl. maintenance, infrastructure and vehicles	Direct link to lower costs of the regional lines	State of art in 2020 (including results from S2R)	CCS system (CAPEX and OPEX) -25% Track side railway assets (OPEX) -30% Rolling Stock (CAPEX & OPEX) – 50%	CCS system (CAPEX and OPEX) -25% Track side railway assets(OPEX) -30% Rolling Stock (CAPEX & OPEX) – 50%[3]
		Maintenance costs, including thanks to the use of digital twins, €	Direct link to lower costs	State of art in 2020 (including results from S2R)	up to -55% depending of Use Cases	-10%[4]
		Design and manufacturing costs, €	Leading to reduced investment cost	State of art in 2020 (including results from S2R)	up to -20% depending of Use Cases	-20%

		Virtual certification tasks that can be conducted in a laboratory, #	Cost of virtual certification activities is much lower than cost of physical certification activities, hence more tasks done virtually leads to lower costs	State of art in 2020 (including results from S2R)	80%	+80%[5]
4	Sustainable and resilient transport	Optimized energy consumption and higher punctuality in regional services, kWh per pax-km or tons-km; mins	More efficient operations, leading to lower energy consumption (with lower CO2 emissions)	State of art in 2020 (including results from S2R)	*Energy consumption -10% Punctuality +15%	-10% (energy); +15% (punctuality)
		CO2 equivalent emissions	Further decrease rail carbon intensity	State of art in 2020 (including results from S2R)	Up to 24% CO2 reduction depending of Use Cases	Up to 30% for specific use cases (e.g. regional operation and heavy duty inspection vehicles)
		Traffic prediction performance, secs	Improve network resilience through dynamic infrastructure restriction handling, train regulation and automated conflict resolution	State of art in 2020 (including results from S2R)	<120 secs	<120 secs[6]
		Time to respond and resolve a vulnerability (regarding cyber security), mins	Reduced impact of events and increased availability of the rail system	State of art in 2020 (including results from S2R)	*	tbc[7]
5	Harmonized approach	CCS system CAPEX and OPEX (of main line and regional lines systems (while maintaining or increasing the present safety level	Reducing costs associated with the interoperability of the network will enhance harmonization	State of art in 2020 (including results from S2R)	25%*	CAPEX: -25% (regional lines) and -10% (main lines); OPEX -20% (regional and main lines)

		No new national technical rules triggered by innovative solutions coming from the Joint Undertaking and potential reduction of national rules in relation to ERTMS and interlocking	By decreasing the amount of national rules in force, rail transport will evolve towards the Single European Railway Area	State of art in 2020 (including results from S2R)	*	N/A
		Reduction of answering time between the short-term request of a cross-border train path and the answer with a firm offer, mins	Indicator for more efficient border crossing	State of art in 2020 (including results from S2R)	Down to 5 mins	Down to 5 mins
		Operational dwell time at borders and other handover points relying also on relying on more homogenous system approaches (leading to increase in number of trains on given infrastructure), mins	Indicator for more efficient border crossing	State of art in 2020 (including results from S2R)	50%	-50%
6	Reinforced role for rail	Accuracy in total planned travel time of passengers from improved matching between supply and demand, %	The combination of the indicators from Impact Areas 1 and 3 contribute to more effective and cost-efficient rail transport, thereby improving attractiveness of rail compared with other transport modes	State of art in 2020 (including results from S2R)	75%	75%
		Traffic planning certainty, #		State of art in 2020 (including results from S2R)	Between 65% and 80%	Between 65% and 80%[1]
		Handling/response time for intermodal freight offers and regional passenger services, mins		State of art in 2020 (including results from S2R)	50%	-50%
		Overall OPEX and CAPEX costs of regional lines, incl. maintenance, infrastructure and vehicles		State of art in 2020 (including results from S2R)	CCS system (CAPEX and OPEX) -25% Track side railway assets (OPEX) -30% Rolling Stock (CAPEX & OPEX) – 50%[33]	CCS system (CAPEX and OPEX) -25% Track side railway assets(OPEX) -30% Rolling Stock (CAPEX & OPEX) – 50%[33]

		Maintenance costs, including thanks to the use of digital twins, €		State of art in 2020 (including results from S2R)	up to -55% depending of Use Cases	-10%[4]
		Design and manufacturing costs, €		State of art in 2020 (including results from S2R)	up to -20% depending of Use Cases	-20%
		Virtual certification tasks that can be conducted in a laboratory, #		State of art in 2020 (including results from S2R)	80%	+80%[5]
7	Improved	Maturity of innovative technologies	Innovative technologies will deploy rail capabilities and leverage potential competitive advantages for the EU rail industry	State of art in 2020 (including results from S2R)	up to TRL 7	TRL 8

[1] Depending on point in time, e.g. one week in advance or one hour in advance

[2] At the moment this KPI is limited with the outcome of FA2 only, in the course of the Programme a consolidated KPI will be measured

[3] The nature of the activity requires a full system approach analysis from improvement at components level, which will be conducted during the course of the Programme

[4] In specific use cases for both rolling stock and infrastructure and asset management

[5] Costs only related to the execution of the on-site tests

[6] In a typical scenario of at least 100 trains running in a 2h interval ahead of actual time

[7] Due to the confidentiality nature of the baseline, a KPI measure will be assessed and consolidated during the course of the Programme

[8] As reflected in the ERA database(s) in relation to OPE TSI Appendix A, annex C and other TSIs in relation to ERTMS and interlocking

* As indicated, a Europe's Rail KPI model is under development.

ANNEX G: IKAA REPORT

As the EU-Rail started officially on 30 November 2021, the operational activities performed in 2022. 2023 and 2024 in relation to EU-Rail are summarized in this current section Annex G. All Private Founding Members shall report about the Amount of certified IKAA for the year 2024 by 31 May 2025.

Consequently, this section includes the IKAA reported and certified by 31 May 2024.

IKAA Report 2024

IKAA OVERVIEW 2022-2024	***IKAA PLANNED (2022+2023)***	***IKAA CERTIFIED (2022+2023)[94]***	***IKAA PLANNED 2024***	***IKAA CERTIFIED 2024[95]***
1. Support to additional R&I	***63.170.465,20***	***88.549.243,50***	***54.009.962,48***	***46.670.676,70***
Additional activities are part and contribute to the Member's activities performed and described within the Exploratory Research Projects in the context of achieving the objectives and KPIs of the related Flagship Area	*-*	*-*	*63.500,00*	*21.462,05*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 1 in the context of achieving the objectives and KPIs of the related Flagship Area	*8.797.217,56*	*19.480.150,75*	*9.233.204,30*	*4.232.947,64*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 2 in the context of achieving the objectives and KPIs of the related Flagship Area	*18.640.678,24*	*21.234.976,76*	*6.406.085,87*	*19.402.418,47*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 3 in the context of achieving the objectives and KPIs of the related Flagship Area	*14.926.859,50*	*18.038.884,88*	*11.544.442,70*	*6.486.265,09*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 4 in the context of achieving the objectives and KPIs of the related Flagship Area	*9.575.674,16*	*11.295.285,03*	*5.851.186,71*	*6.624.257,64*

[94] The grand total amount is higher from what was reported at the AAR 2023 (EUR 92.5 m) as not all Private Members had submitted their IKAA reporting by the 31/05/2024.

[95] The amounts correspond to the IKAA reporting received by the Private Members by 31/05/2025.

Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 5 in the context of achieving the objectives and KPIs of the related Flagship Area	*5.437.197,52*	*8.268.067,78*	*4.220.987,00*	*7.523.172,84*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 6 in the context of achieving the objectives and KPIs of the related Flagship Area	*1.629.217,22*	*8.681.664,48*	*10.671.608,86*	*1.104.355,50*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Projects 7 in the context of achieving the objectives and KPIs of the related Flagship Area	*10.000,00*	*-*	*386.914,00*	*117.886,77*
Asset Management wayside monitoring and decision management tools	*-*	*-*	*96.000,00*	
ATO functions & integration ATO-OB with ETCS-OB | ATO-TS	*-*	*-*	*300.000,00*	
Automation Island	*-*	*-*	*208.283,94*	
DAC / DAK activities outside ERJU projects	*-*	*-*	*400.000,00*	*91.633,04*
Data space for railway	*-*	*-*	*128.279,02*	
Digital Twin activities outside ERJU projects	*-*	*-*	*100.000,00*	
Intuitive design of remote control centers	*-*	*-*	*113.305,50*	
Monitoring and Maintenance of vehicle systems	*-*	*-*	*43.440,00*	
Neuromorphic hardware for railways	*-*	*-*	*44.651,98*	
OCORA: Non-funded activities	*300.000,00*	*-*	-	
Project NGT Fun System dynamics: Non-funded activities	*473.000,00*	*-*	*64.840,00*	
Project ProCo: Non-funded activities	*517.700,80*	*-*	*256.620,00*	
Project RoSto: Non-funded activities	*163.332,00*	*-*	*300.000,00*	
Projects InTra & TraCo: Non-funded activities	*548.967,20*	*-*	*1.102.588,35*	

Projects VMo4Orte, RoSto, ProCo: Non-funded activities	*17.000,00*	*-*	*250.000,00*	
R&D internal projects related to and complementary to ERJU FAs topics.	*13.000,00*	*22.174,67*	*-*	*-*
Real-time guarantees description language and contracts	*-*	*-*	*176.137,00*	*-*
Remote train operation	*-*	*-*	*45.000,00*	*-*
System Pillar: Non-funded activities	*250.000,00*	*-*	*-*	*-*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 3 in the context of achieving the objectives and KPIs of the related Flagship Area	*1.870.621,00*	*1.528.039,15*	*1.441.387,25*	*1.066.277,66*
2. Scale-up of technologies	***7.270.563,44***	***7.714.842,93***	***5.011.023,91***	***4.594.724,64***
Acount based ticketing and new validation systems	*200.000,00*	*-*	*-*	
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 1 in the context of achieving the objectives and KPIs of the related Flagship Area	*4.278.980,00*	*3.898.270,84*	*2.370.382,67*	*2.185.501,00*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 2 in the context of achieving the objectives and KPIs of the related Flagship Area	*489.651,00*	*1.792.240,85*	*550.951,00*	*1.701.618,35*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 3 in the context of achieving the objectives and KPIs of the related Flagship Area	*530.295,00*	*354.998,75*	*375.000,00*	
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 4 in the context of achieving the objectives and KPIs of the related Flagship Area	*176.000,00*	*-*		
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 5 in the context of achieving the objectives and KPIs of the related Flagship Area	*589.677,44*	*1.520.141,37*	*1.164.690,24*	*581.206,00*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 6 in the context of achieving the objectives and KPIs of the related Flagship Area	*305.960,00*	*149.191,12*	*160.000,00*	*126.399,29*

ATO Functionality	*200.000,00*	*-*	*-*	*-*
Moving Block -TRL 5 to 7	*500.000,00*	*-*	*380.000,00*	*-*
3. Demonstrators	***13.438.166,76***	***6.728.048,53***	***9.836.732,70***	***3.423.580,55***
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 1 in the context of achieving the objectives and KPIs of the related Flagship Area	*1.564.383,60*	*988.240,73*	*638.405,54*	*197.366,46*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 2 in the context of achieving the objectives and KPIs of the related Flagship Area	*1.284.892,36*	*213.745,03*	*966.330,05*	*1.070.114,77*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 3 in the context of achieving the objectives and KPIs of the related Flagship Area	*2.033.178,72*	*789.686,36*	*1.167.574,97*	*732.656,13*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 4 in the context of achieving the objectives and KPIs of the related Flagship Area	*2.090.211,09*	*1.657.895,58*	*3.795.046,41*	*40.417,40*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 5 in the context of achieving the objectives and KPIs of the related Flagship Area	*5.830.500,99*	*2.936.990,69*	*2.654.375,73*	*1.061.590,58*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 6 in the context of achieving the objectives and KPIs of the related Flagship Area	*635.000,00*	*141.490,14*	*615.000,00*	*321.435,21*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Projects 7 in the context of achieving the objectives and KPIs of the related Flagship Area	*-*	*-*		*-*
4. Creating new business opportunities	***63.699,00***	***452.797,00***	***1.035.000,00***	***181.214,09***
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 6 in the context of achieving the objectives and KPIs of the related Flagship Area	*-*	*-*	*800.000,00*	*-*
Software DISC EMAN	*63.699,00*	*452.797,00*	*235.000,00*	*181.214,09*
5. Training and skills development	***1.425.402,51***	***114.373,20***	***408.234,00***	***-***

Additional activities are part and contribute to the Member's activities performed and described within the Exploratory Research Projects in the context of achieving the objectives and KPIs of the related Flagship Area	*-*	*-*	*4.000,00*	*-*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 1 in the context of achieving the objectives and KPIs of the related Flagship Area	*1.400.000,00*	*92.000,00*		*-*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 2 in the context of achieving the objectives and KPIs of the related Flagship Area	*22.402,51*	*18.858,20*	*8.000,00*	*-*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 3 in the context of achieving the objectives and KPIs of the related Flagship Area	*3.000,00*	*3.515,00*		*-*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 4 in the context of achieving the objectives and KPIs of the related Flagship Area	*-*	*-*	*374.234,00*	*-*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 6 in the context of achieving the objectives and KPIs of the related Flagship Area	*-*	*-*	*22.000,00*	*-*
6. Contribution to the development of new standards, regulations and policies	***96.964,22***	***130.854,68***	***770.000,00***	***160.560,41***
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 2 in the context of achieving the objectives and KPIs of the related Flagship Area	*-*	*-*	*-*	*-*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 3 in the context of achieving the objectives and KPIs of the related Flagship Area	*-*	*-*	*439.000,00*	*160.560,41*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 6 in the context of achieving the objectives and KPIs of the related Flagship Area	*-*	*-*	*56.000,00*	*-*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Projects 7 in the context of achieving the objectives and KPIs of the related Flagship Area	*19.320,87*	*11.594,13*	*10.000,00*	*-*

Project "Querkraftverstärkung bei Brücken mit glatten Stäben": Non-funded activities	*-*	*-*	*40.000,00*	*-*
Project "TDR – Tunnel Drainage Rover": Non-funded activities	*-*	*-*	*80.000,00*	*-*
System Pillar: Non-funded activities	*77.643,35*	*119.260,55*	*145.000,00*	*-*
7. Supporting ecosystem development	***3.807.200,00***	***122.540,00***	***1.232.900,01***	*-*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 1 in the context of achieving the objectives and KPIs of the related Flagship Area	*2.500.000,00*	*-*	*821.264,83*	*-*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 4 in the context of achieving the objectives and KPIs of the related Flagship Area	*237.100,00*	*-*	*311.635,18*	*-*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 5 in the context of achieving the objectives and KPIs of the related Flagship Area	*770.100,00*	*122.540,00*	*-*	*-*
Participation in national organisations and possible pilots and support of initiatives in the shape of contributions towards new concepts and ideas (Railforum, Energy Roundtable, etc.)	*300.000,00*	*-*	*100.000,00*	*-*
8. Communication, dissemination, awareness raising, citizen engagement	***253.675,39***	***36.965,72***	***519.250,00***	***-***
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 1 in the context of achieving the objectives and KPIs of the related Flagship Area	*-*	*-*	*1.250,00*	*-*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 2 in the context of achieving the objectives and KPIs of the related Flagship Area	*33.675,39*	*36.965,72*	*20.000,00*	*-*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 3 in the context of achieving the objectives and KPIs of the related Flagship Area	*-*	*-*	*13.000,00*	*-*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 4 in the context of achieving the objectives and KPIs of the related Flagship Area	*-*	*-*	*10.000,00*	*-*

Participation in conferences and/or seminars to communicate and disseminate knowledge	*220.000,00*	*-*	*475.000,00*	*-*
9. Other	***3.017.780,00***	***930.409,74***	***1.070.701,05***	***345.740,51***
Additional activities related to the EU -RAIL program	*-*	*-*	*160.000,00*	*-*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 1 in the context of achieving the objectives and KPIs of the related Flagship Area	*417.000,00*	*-*	*240.000,00*	*-*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 2 in the context of achieving the objectives and KPIs of the related Flagship Area	*450.000,00*	*-*	*-*	*-*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 3 in the context of achieving the objectives and KPIs of the related Flagship Area	*353.920,00*	*-*	*138.967,44*	*-*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 4 in the context of achieving the objectives and KPIs of the related Flagship Area	*-*	*-*	*2.074,61*	*-*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 5 in the context of achieving the objectives and KPIs of the related Flagship Area	*1.255.860,00*	*424.451,74*	*529.659,00*	*345.740,51*
Additional activities are part and contribute to the Member's activities performed and described within the Flagship Project 6 in the context of achieving the objectives and KPIs of the related Flagship Area	*30.000,00*	*-*	*-*	*-*
Design for the implementation of an IT platform, for use by all actors in the supply chain	***511.000,00***	***505.958,00***		*-*
Grand Total	***92.543.916,52***	***104.780.075,30***	***73.883.804,39***	***55.376.496,90***

Country	IKAA PLANNED (2022+2023)	IKAA CERTIFIED (2022+2023)	IKAA PLANNED 2024	IKAA CERTIFIED 2024
Austria	6.652.460,00	7.097.672,83	3.511.000,00	1.775.466,23
Belgium	717.500,00	-	1.116.000,00	1.135.579,67
Czechia	1.389.699,00	2.817.084,92	941.000,00	2.196.848,65
France	8.636.028,94	24.349.627,25	19.480.547,86	2.782.871,19
Germany	21.692.283,66	29.717.724,97	13.559.535,79	23.519.449,83
Hungary	589.677,44	2.257.179,37	1.164.690,24	1.131.074,00
India	52.000,00	446.242,93	26.000,00	82.126,00
Italy	14.972.015,00	13.153.903,95	11.275.474,51	7.245.844,56
Netherlands	9.119.000,00	5.430.604,00	2.379.315,06	1.223.250,00
Norway	870.000,00	647.335,88	870.000,00	1.122.533,00
Poland	2.114.454,00	-	1.781.713,32	8.545,52
Portugal	30.000,00	-	-	
Spain	19.352.263,48	13.606.341,19	11.722.638,12	6.560.606,25
Sweden	4.350.535,00	2.809.164,59	4.393.389,50	4.221.704,00
Switzerland	1.366.000,00	1.062.337,75	801.250,00	2.034.675,57
United Kingdom	-	-	61.250,00	14.171,27
USA	640.000,00	1.384.855,67	800.000,00	321.751,16
Grand Total	**92.543.916,52**	**104.780.075,30**	**73.883.804,39**	**55.376.496,90**

TOTAL IKAA 2022- 2024 (Evolution - Value in €)		
Planned IKAA	**Reported IKAA with pending certification**	**Certified IKAA**
166.427.720,91	**16.335.329,07**	***161.166.833,13***

ANNEX H: FINAL ANNUAL ACCOUNTS

Balance Sheet

	Note	31.12.2024	31.12.2023
NON-CURRENT ASSETS			
Intangible assets	*2.1*	-	-
Property, plant and equipment	*2.2*	39.027,00	79.798,00
Long term pre-financing	*2.3*	30.954.617,70	69.719.201,26
		30.993.644,70	**69.798.999,26**
CURRENT ASSETS			
Short term pre-financing	*2.3*	67.541.911,37	71.976.851,50
Exchange receivables and non-exchange recoverables	*2.4*	55.602.782,27	54.323.477,81
Cash and cash equivalent	*2.5*	-	-
		123.144.693,64	**126.300.329,31**
TOTAL ASSETS		**154.138.338,34**	**196.099.328,57**
CURRENT LIABILITIES			
Payables and other liabilities	*2.7*	134.302.526,07	102.862.624,93
Accrued charges and deferred income	*2.8*	59.998.444,62	90.551.257,37
		194.300.970,69	**193.413.882,30**
TOTAL LIABILITIES		**194.300.970,69**	**193.413.882,30**
Contribution from Members	*2.9*	997.927.296,32	908.611.861,66
Accumulated deficit		(905.926.415,39)	(712.896.116,39)
Economic result of the year		(132.163.513,28)	(193.030.299,00)
NET ASSETS		**(40.162.632,35)**	**2.685.446,27**
LIABILITIES AND NET ASSETS		**154.138.338,34**	**196.099.328,57**

Statement of financial performance

	Note	2024	2023
REVENUE			
Revenue from non-exchange transactions			
Recovery of operating expenses	3.1	189.086,26	125.901,38
Other non-exchange revenue	3.2	141.581,35	-
Financial revenues	3.2	5.514,70	11.087,51
Revenue from exchange transactions	3.3		
Other exchange revenue		33,00	15.260,00
Total revenue		**336.215,31**	**152.248,89**
EXPENSES			
Operating costs	3.4	(127.518.813,49)	(188.711.323,66)
Staff costs	3.5	(2.612.852,87)	(2.513.179,05)
Financial expenses	3.6	(3.372,16)	(1.125,81)
Other expenses	3.7	(2.364.690,07)	(1.956.919,37)
Total expenses		**(132.499.728,59)**	**(193.182.547,89)**
ECONOMIC RESULT OF THE YEAR		**(132.163.513,28)**	**(193.030.299,00)**

Cash flow statement

	2024	2023
Economic result of the year	(132.163.513,28)	(193.030.299,00)
Operating activities		
Depreciation and amortization	49.841,24	55.703,80
(Increase)/decrease in pre-financing	43.199.523,69	(18.819.007,57)
(Increase)/decrease in exchange receivables and non-exchange recoverables	(1.279.304,46)	9.034.570,33
Increase/(decrease) in payables	31.439.901,14	17.739.447,74
Increase/(decrease) in accrued charges & deferred income	(30.552.812,75)	37.520.062,00
Increase/(decrease) in cash contributions	40.619.627,35	85.252.678,62
Increase/(decrease) in in-kind contributions	48.695.807,31	62.263.283,88
Other non-cash movements	-	-
Investing activities		
(Increase)/decrease in intangible assets and property, plant and equipment	(9.070,24)	(16.439,80)
NET CASHFLOW	**-**	**-**
Net increase/(decrease) in cash and cash equivalents	-	-
Cash and cash equivalents at the beginning of the year	-	-
Cash and cash equivalents at year-end	-	-

Statement of changes in net assets

	Contribution from Members	Accumulated Surplus/(Deficit)	Economic result of the year	Net Assets
BALANCE AS AT 31.12.2022	**761.095.899,16**	**(567.167.034,40)**	**(145.729.081,99)**	**48.199.782,77**
Allocation 2022 economic result	-	(145.729.081,99)	145.729.081,99	-
Cash contribution	86.213.991,22	-	-	86.213.991,22
Contribution in-kind	62.263.283,88	-	-	62.263.283,88
Unpaid cash contributions	(961.312,60)	-	-	(961.312,60)
Economic result of the year	-	-	(193.030.299,00)	(193.030.299,00)
BALANCE AS AT 31.12.2023	**908.611.861,66**	**(712.896.116,39)**	**(193.030.299,00)**	**2.685.446,27**
Allocation 2023 economic result	-	(193.030.299,00)	193.030.299,00	-
Cash contribution	40.415.478,95	-	-	40.415.478,95
Contribution in-kind	48.695.807,31	-	-	48.695.807,31
Unpaid cash contributions	204.148,40	-	-	204.148,40
Economic result of the year	-	-	(132.163.513,28)	(132.163.513,28)
BALANCE AS AT 31.12.2024	**997.927.296,32**	**(905.926.415,39)**	**(132.163.513,28)**	**(40.162.632,35)**

ANNEX I: MATERIALITY CRITERIA

This Annex provides explanation on how the EU-Rail Executive Director defined the materiality threshold as a basis for determining whether significant weaknesses should be subject to a formal reservation to his declaration of assurance. Both qualitative and quantitative criteria were set in this regard, as follows.

Qualitative criteria

Significant weaknesses in the internal control system

Deficiencies in EU-Rail's internal control system (ICS) considered significant, meaning that the existence of such deficiencies does not allow to conclude that the concerned ICS Component(s) and/or the ICS as a whole is present and functioning. ICS weaknesses may be identified by the JU's management activities, through dedicated self-assessment exercises, by internal or external auditors or by a third party, as applicable.

Critical issues outlined by the European Court of Auditors, the Internal Audit Service and OLAF

Any findings/observations made by the ECA, the IAS or OLAF, which, given their nature and/or magnitude, indicate serious deficiencies in management of risks or in the design and implementation of the internal control system at EU-Rail. Significant delay in the implementation of the action plan addressing previously issued critical findings/observations of ECA/IAS/OLAF may also be taken into account.

Significant reputational events

Events or weaknesses which have a significant reputational impact on EU-Rail, on the associated Commission services (DG MOVE, DG RTD), or on the European Union as such, irrespective of the amount of damage to EU-Rail's administrative and operational budget, will be considered for issuing a reservation to the declaration of assurance.

Quantitative criteria applicable to the JU's Programme falling under Horizon 2020 (S2R Programme)

Residual error rate

Given the fact that more than 90% of the JU's operational expenditure allocated to the H2020 Programme was related to its grants, the focus of assurance in terms of the legality and regularity of the underlying transactions will therefore principally be on the level of errors identified in the ex-post audits of cost claims in grants on a multi-annual basis. These ex-post audits are carried out by the CAS based on a common audit approach shared among the research framework programmes' implementing bodies.

As a result of its multiannual nature, the effectiveness of the EU-Rail's controls can only be fully measured and assessed at the final stages of the Programme's lifetime once the ex-post audit strategy has been fully implemented and systematic errors have been detected and corrected.

In this respect, the decision on whether the ED needs to make a formal reservation to his declaration of assurance for the respective financial year is based on the value of the JU's residual error rate. This should, as follows from the common R&I Family target expressed in the legislative financial statement accompanying the Commission's proposal for the Horizon 2020 regulation, remain within a range of 2 to 5%, aiming to be as close as possible to 2%. However, the JU's control objective is to ensure for the H2020 Programme, that the residual error rate, which represents the level of errors that remain undetected and uncorrected, does not exceed 2% of the total expense recognised until the end of the Programme. Nevertheless, even before the end of the Programme, if the value of the residual error rate is not below 2% at the end of the respective reporting year, the ED might still make a reservation. For this, in addition to this quantitative threshold, the qualitative aspects of the underlying weaknesses will be considered as well before finally deciding on making a reservation, such as:

- The nature and scope of the weaknesses;
- The duration of the weaknesses;
- The existence of compensatory measures (mitigating controls which reduce the impact of the weaknesses);
- The existence of effective corrective actions to correct the weaknesses (action plans and financial corrections) which have had a measurable impact.

The starting point to determine the effectiveness of the controls in place is the "representative error rate" expressed as a percentage of errors in favour of the JU detected by ex-post audits measured with respect to the amounts accepted after ex-ante controls.

The representative error rate will be calculated as the weighted average (WAER) for a population, from which a representative sample has been drawn, according to the following formula:

$$WAER\% = \frac{\Sigma\,(err)}{A} = RepER\%$$

Where:

Σ (err) = sum of all individual error rates of the sample (in value). Only those errors in favour of the JU will be taken into consideration.

A = total amount of the representative audited sample expressed in EUR.

Second step - calculation of the residual error rate:

To take into account the impact of the ex-post controls, this error level is to be adjusted by subtracting:

- errors detected and corrected as a result of the implementation of audit conclusions;
- errors corrected as a result of the extrapolation of audit results to non-audited contracts with the same beneficiary.

This results in a residual error rate, which is calculated by using the following formula:

$$ResER\% = \frac{(RepER\% * (P - A)) - (RepERsys\% * E)}{P}$$

Where:

ResER% = residual error rate, expressed as a percentage.

RepER% = representative error rate, or error rate detected in the representative sample, in the form of the WAER, expressed as a percentage and calculated as described above (WAER%).

RepERsys% = systematic portion of the RepER% (the RepER% is composed of complementary portions reflecting the proportion of 'systematic' and 'non-systematic' errors detected) expressed as a percentage.

P = total amount of the auditable population of cost claims, expressed in EUR.

A = total of all audited amounts, expressed in EUR.

E = total non-audited amounts of all audited beneficiaries. This will comprise the total amount, expressed in EUR, of all non-audited but validated and paid costs for all audited beneficiaries, excluding those beneficiaries for which an extrapolation is ongoing.

This calculation will be performed on a point-in-time basis, i.e. all the figures will be provided as of a certain date.

ANNEX J: LIST OF ACRONYMS

Abbreviation	
ABAC	Accrual Based Accounting
ADI	Austempered Ductile Iron
AO	Authorising Officer
ATO	Automated Train Operation
AWP	Annual Work Plan
BOA	Back Office Arrangements
CA	Commitment Appropriation
CAAR	Consolidated Annual Activity Report
CAS	Common Audit Service
CAPEX	Capital Expenditure
CBM	Condition-Based Maintenance
CBO	Common Business Objectives
CBTC	Communication Based Train Control
CCA	Cross Cutting Activities
CEN	European Committee for Standardisation
CENELEC	European Committee for Electrotechnical Standardisation
CFM	Call for Members
Covid-19	'CO' stands for corona, 'VI' for 'virus, and 'D' for disease. Formerly, this disease was referred to as '2019 novel coronavirus' or '2019-nCoV.' The COVID-19 virus is a new virus linked to the same family of viruses as Severe Acute Respiratory Syndrome (SARS) and some types of common cold.
CRS	Common Representative Sample
CREL	Core Release
CSA	Coordination and support action
CW	Cloud Wallet
DOI	Digital Object Identifier
DRIMS	Dynamic Railway Information Management System
EC	European Commission
ECA	European Court of Auditors
ED	Executive Director
EDPS	European Data Protection Supervisor
ED-SIPB	ED System and Innovation Programme Board
EDV	Electronic Distributor Valve

EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EN	European Norm
ERA	European Union Agency for Railways
ERRAC	European Rail Research Advisory Council
ERTMS	European Rail Traffic Management System
ETCS	European Train Controlling System
EU	European Union
EUAN	European Union Agencies Network
EUG	ERTMS Users Group
EU-Rail	The Europe's Rail Joint Undertaking
FACTs	Flexible AC Transmission Systems
FFFIS	Form Fit Functional Interface Specifications
FIS	Functional Interface Specifications
FREL	Final Release
GA	Grant Agreement
GAP	Grant Agreement Preparation
GDPR	General Data Protection Regulation
GIS	Geographic Information System
GNSS	Global Navigation Satellite System
GoA	Grade of Automation
H2020	Horizon 2020, EU framework programme for Research and Innovation
HST	High-Speed Train
HVAC	Heating, Ventilation Air Conditioning and Cooling
IA	Innovation Action
IAMS	Intelligent Asset Management System
IAS	Internal Audit Service
ICT	Information and Communications Technology
IEC	International Electrotechnical Commission
IKAA	in-kind contributions to additional activities
IP	Innovation Programme/Innovation Pillar
IPR	Intellectual Property Rights
ISO	International Standardisation Organisation
IT	Information Technology

ITD	Integrated Technology Demonstrator
JTI	Joint Technology Initiative
JU	Joint Undertaking
KPI	Key Performance Indicator
LCC	Life Cycle Cost
LIDAR	Light Detection and Ranging
LP	Lighthouse Project
LTE	Long-Term Evolution (standard for wireless communication)
MAAP	Multi-Annual Action Plan
MaaS	Mobility as a Service
MB(S)	Moving block (System)
MC	Mission Critical
MNO	Mobile Network Operator
NaaA	Network as an Asset
NaaS	Network as a Service
NLOS	non-line-of-sight
NTP	Network Time Protocol
OC	Open Call
ODM	Operational Data Management
OMTS	On-board Multimedia and Telematics Services
OPEX	Operating Expenditure
PA	Payment Appropriation
RCA	Railway Command Control and Signalling Architecture
R&I	Research and Innovation
PPP	Public Private Partnership
PRM	Persons with Reduced Mobility
PTC	Positive Train Control
PTI	Platform Train Interface
QoA	Quality of Service
RAL	Unpaid amount
RAMS	Reliability and Maintainability System
RBC	Radio Block Centre
RFID	Radio Frequency Identification
RIA	Research and innovation action

RoI	Return of Investment
S2R	Shift2Rail
SBA	The Single Basic Act - Council Regulation (EU) 2021/2085 of 19 November 2021 establishing the Joint Undertakings under Horizon Europe
SC	Scientific Committee
SDG	Sustainable Development Goals
SETA	Single European Transport Area
SEMP	System Engineering Management Plan
SiC	Silicon Carbide
SIR	Staff Implementing Rules
SLA	Service Level Agreement
SME	Small and Medium Enterprise
SNE	Seconded National Expert
SP	System Pillar
SPD	System Platform Demonstration
SPSG	System Pillar Steering Group
SRG	States Representatives Group
SSG	Scientific Steering Group
SWL	Single Wagon Load
TAF	Telematic Application for Freight
TAP	Telematic Application for Passengers
TCMS/NG-TCMS	Train Control and Monitoring System/Next Generation Train Control and Monitoring System
TCO	Total Cost of Ownership
TD	Technology Demonstrator
TL	Train Load
TMS	Traffic Management System
TRL	Technology Readiness Level
TSI	Technical Specifications for Interoperability
TSP	Travel Service Provider
UAV	Unmanned Aerial Vehicle
UG	User Group
UN	United Nations
WA	Work Area

WP	Work Package
WSP	Wheel Slide Protection

ANNEX K: INFORMATION PERTAINING TO THE FORMER SHIFT2RAIL JOINT UNDERTAKING

List of Members of the S2R JU until 29/11/2021

Factsheet of the S2R JU as at 29/11/2021

Name	Shift2Rail Joint Undertaking (also referred to as "S2R JU" or "S2R")
Objectives	The Shift2Rail Joint Undertaking is a public-private partnership in the rail sector, providing a platform for cooperation that drives innovation in the years to come. The S2R JU pursues research and innovation (R&I) activities in support of the achievement of the Single European Railway Area and should improve the attractiveness and competitiveness of the European rail system. The S2R JU contributes to: • 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). The S2R JU shall propose innovative solutions to be explored, tested and demonstrated in operational environment and/or "zero on site" to achieve market uptake. Beyond that, with the deployment of its innovative solutions the S2R JU will foster connections between people, regions, cities, and businesses, supporting the socioeconomic objectives of the Union.
Founding Legal Act	Council Regulation (EU) No 642/2014 of 16 June 2014 establishing the Shift2Rail Joint Undertaking[96] (S2R Regulation)
Executive Director (ED)	Mr Carlo M. Borghini, as from 16 May 2016
Governing Board (S2R GB) **As at end of Jan 2021**	***European Commission (EC) members:*** • *Henrik Hololei*, DG MOVE ***EC alternates:*** • MOVE DDG 2 *Kristian Schmidt* • RTD D *Rosalinde Van Der Vlies* ***Industry members:*** • ALSTOM *Nicolas Castres Saint Martin* • AŽD Praha *Vladimir Kampik* • BOMBARDIER TRANSPORTATION *Nicolas Castres Saint Martin*

[96] OJ L 177, 17.6.2014, p. 9

	• CAF — *Imanol Iturrioz* • DEUTSCHE BAHN — *Hans Peter Lang* • EUROC — *Thomas Petraschek* • HACON — *Lars Deiterding* • HITACHI RAIL STS — *Antonella Trombetta* • INDRA — *Javier Rivilla Lizano* • KNORR-BREMSE — *Hans-Christian Hilse* • NETWORK RAIL — *Robert Ampomah* • SIEMENS — *Roland Edel* • SMARTDEMAIN — *Henk Samson* • SMARTRACON — *Michael Meyer zu Hörste* • SNCF — *Carole Desnost* • THALES — *Yves Perreal (Industrial Spokesperson)* • TRAFIKVERKET — *Bo Olsson* • VVAC+ — *Filip Kitanoski* ***Industry alternates:*** • ALSTOM — *Sophie Perrocheau* • AŽD Praha — *Michal Pavel* • BOMBARDIER TRANSPORTATION — *Richard French* • CAF — *Jorge De Castro* • DEUTSCHE BAHN — *Ralf Marxen* • EUROC — *not appointed* • HACON — *Rolf Gooßmann* • HITACHI RAIL STS — *Claudio Monti* • INDRA — *not appointed* • KNORR-BREMSE — *Jasmina Brackovic* • NETWORK RAIL — *Felicity Osborn* • SIEMENS — *Jürgen Schlaht* • SMARTDEMAIN — *Javier Bonilla Díaz* • SMARTRACON — *Jaizki Mendizabal* • SNCF — *Christophe Cheron* • THALES — *Alberto Parrondo* • TRAFIKVERKET — *Christer Lofving*

	• VVAC+ *Erik Stocker* ***Other participants:*** • *Carlo M Borghini* Executive Director of EU-Rail ***Observers:*** • *Josef Doppelbauer* (ERA) • *Ana Gigantino* (ERA) • *Ny Tiana Tournier* (ERA) • *Angela Di Febbraro* (SC Chair) • *Sarah Bittner-Krautsack* (SRG Chair) • *Miroslav Haltuf* (SRG Vice Chair)
Other bodies	Scientific Committee (SC) States Representatives Group (SRG) Innovation Programmes' Steering Committees (IP SteCos)
Strategic Research Agenda	In accordance with the S2R Regulation, the strategic research and innovation agenda of the S2R JU is described in the Multi-Annual Action Plan (MAAP) adopted in its latest version in November 2019, by means of the GB Decision N° 9/2019. The original MAAP of 2015 is maintained as a reference document.

ANNEX L: LIST OF MEMBERS OF THE EUROPE'S RAIL JOINT UNDERTAKING[97]

[97] As from the date of the adoption of the report in 2025

RAIL-RESEARCH.EUROPA.EU