

unife



Research & *Innovation*

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Hard copies of the UNIFE R&I brochure are available at UNIFE's offices
This publication is also available online at **www.unife.org**

Foreword

by UNIFE Director General
Philippe Citroën



Rail is central to modern European life, its dense network that links Member States across the continent allow citizens to access resources in their community, build their businesses and enjoy safe, reliable, accessible and sustainable transport on a daily basis. Europe's rail supply industry, composed of manufacturers of all sizes and employing over 400.000 in the EU, generate and provide transport solutions that will prove to be essential to creating a decarbonised mobility paradigm fit for the digital age. As the overwhelming provider of European rail products, and a global leader internationally, the European rail supply industry relies on research and innovation (R&I) to remain at the forefront of transportation needs. Doing so allows European rail suppliers to overcome competitive challenges our industry faces in an increasingly contested global economy while improving our attractiveness to passengers and end users – critical to inspiring a modal shift compatible with the mounting need for climate action.

Demonstrating its commitment to next generation technology, the European Rail Supply Industry – including significant contributions from the growing small- and medium-sized enterprises (SMEs) that represent a growing segment of the community - reinvests about 4% of its annual revenue to R&I activities. This tangible commitment to research allows UNIFE members to remain the vanguard of the international rail supply market through the creation of innovative, high quality and cutting-edge mobility solutions.

Understanding the importance of staying ahead of the curve on emerging technologies has informed all of UNIFE's activities.

Our industry was an earlier adopter of automated train automation and a driving force in implementing driverless metros and **ERTMS**. Our members continue to push the envelope on the integration of geospatial technology, artificial intelligence, digital twins and big data into their platforms and throughout the design process. As research and innovation is always a collaborative effort, UNIFE and its constituent companies were proud to spearhead the creation of the **Shift2Rail Joint Undertaking** and – after its 2021 expiration – its continuation as the new **Europe's Rail Joint Undertaking** through the EU Research Framework Programme - **Horizon Europe**. The former effectively tripled the EU budget for rail research and was initial confirmation

of the significance of public-private collaboration in creating the technological progress that will enable the future **Single European Railway Area** (SERA).

With the introduction of the new joint undertaking and new funding portfolios like Recovery and Resilience Facility, Europe is standing at the precipice of a rail renaissance. Our sector's research and innovation efforts at this moment have the potential of enhancing mobility networks across the continent and positioning our mode of transport as the backbone of a zero-emission multimodality needed for Europe to go carbon neutral by 2050, as called for in the EU Green Deal.

In this brochure, you can find a full catalogue of UNIFE's past, present and future contributions to rail R&I. I would like to take this moment to voice my appreciation of the cooperation of the European institutions and the EU Member States tireless commitment to further developing Europe's rail transportation offerings. Our association and our members look forward to further fruitful collaboration with these bodies and remain driven to realizing the EU's ambitious mobility, sustainability and resiliency objectives.

Philippe Citroën


UNIFE Director General



A female technician with dark hair tied back, wearing clear safety glasses and a white lab coat, is focused on her work. She is operating a large industrial machine, with her hands visible on the controls. The background is a blurred factory floor with blue lighting. The text "About UNIFE" is overlaid in the bottom right corner.

About

UNIFE



Based in Brussels since 1992, UNIFE represents the European rail supply industry at both European and international levels and is a trusted partner of the European Union Institutions in all matters related to rail and transport.

UNIFE represents the interests of more than 100 small, medium and large sized companies in the rail supply industry. These UNIFE member companies are involved in the engineering, design, manufacture, maintenance and refurbishment of rail transport systems, subsystems and related equipment. All segments of the rail industry are represented within the membership: system integrators, railway infrastructure and energy suppliers, rolling stock manufacturers (including subsystem suppliers), signalling suppliers and railway engineering companies. UNIFE members have an 84% market share in Europe and supply more than 46% of the worldwide production of rail equipment and services. UNIFE also brings together 11 national rail industry associations from across Europe.

Our members are committed to providing the best technology to meet the challenges arising from climate change and growing transport volumes. Furthermore, UNIFE, which is one of the supporting bodies of the Europe's Rail Joint Undertaking, the European Union Agency for Railways and the European Rail Research Advisory Council, works on interoperability standards and coordinates EU-funded research projects that work towards the technical harmonisation of railway systems.

System Integrators

UNIFE system integrators provide turnkey railway and urban rail systems-comprising infrastructure, rolling stock and signalling components-throughout the world

Rolling Stock and Subsystems

UNIFE members produce regional, intercity and highspeed trains, electric and diesel locomotives as well as freight wagons for all types of cargo. UNIFE members also produce tramways, metros and Light Rail Transport systems. UNIFE also represents subsystem manufacturers from wheels to pantographs including door systems, couplers, Heating, Ventilation and Air Conditioning units, on board signalling equipment and all the necessary equipment for trains.

Infrastructure and Energy

UNIFE members offer the world's best rail infrastructure/energy products and services: from the supply of rail, track and energy components, installation and maintenance equipment to the provision, building, maintenance and renewal of integrated track and energy systems. Suppliers and contractors deliver and maintain high-quality track infrastructure and energy systems in Europe and around the world.

Signalling and Telecommunication

UNIFE members also produce signalling and telecommunication systems that help increase the capacity of the railway system. They are equally committed to developing European Rail Traffic Management System, a European system that will help overcome the differences between national signalling systems. They also developed actively the Future Railway Mobile Communication System (FRMCS).

For more and up-to-date information on ERTMS, please visit www.ertms.net.

For more and up-to-date information on FRMCS, please visit <https://www.unife.org/committee/unitel-committee/>


Railway Engineering

UNIFE members also provide engineering expertise (e.g. planning, design and supervision works) for rail and urban transport.

A close-up photograph of a man with a beard and dark hair, wearing yellow earphones. He is looking intently at a blurred green object in the foreground. The background is dark and out of focus.

UNIFE

**and European
Rail Innovation
– a rich history**



UNIFE has an extensive and diverse experience with European research and innovation (R&I) projects. During our 30 years of operating in Brussels, this association has served as both an advocate for increased EU funding for rail research and as a partner and coordinator of dozens of projects dealing with various railway subsystems such as rolling stock, infrastructure, signalling, energy, freight and more. We are actively involved in the **European Rail Research Advisory Council's** (ERRAC) secretariat, our sector's European Technology Platform and a trusted partner of the **European Commission**. UNIFE's Research & Innovation Committee is trusted with steering our R&I activities and delivering vital results for the membership.

Perhaps in its most impactful research and innovation accomplishment to date, UNIFE helped instigate the first European rail research public private partnership: the **Shift2Rail Joint Undertaking**. At the time, in 2014, it was the first time that such a European rail R&I partnership was established to bring together various sectoral stakeholders to advance new technologies and solutions for our mode of transport.

Based on the successes of Shift2Rail, UNIFE advocated for the establishment of its successor – now known as the **Europe's Rail Joint Undertaking** (EU-Rail) - within the framework programme for Research & Innovation **Horizon Europe 2021-2027**. EU-Rail was officially launched at the end of 2021, with a budget of roughly €1,2 billion after its official regulation was adopted by **the Council of the European Union**. At the present, 12 UNIFE members are involved in the Joint Undertaking as Founding Members.

Regarding rail R&I, UNIFE seeks to:

- ▶ **Advocate for sufficient European funding** for collaborative research
- ▶ **Advise members on all European Level R&I opportunities**, including providing relevant information on Horizon Europe, Europe's Rail and other R&I programmes concerning satellite technologies, batteries, cybersecurity and digital applications
- ▶ **Coordinate EU R&I projects** essential for the European Rail Supply Industry
- ▶ **Facilitate discussions between stakeholders** interested in setting up research consortia
- ▶ **Represent the rail supply industry** within ERRAC and foster communication between members and railway undertakings, infrastructure managers and academia

UNIFE is also involved in standardisation and regulation activities. Our association aims to sync European research projects and their outputs with the activities of the **European Union Agency for Railways (ERA)**, **CEN/CENELEC** and **International Standardisation Organisation (ISO)**. UNIFE is a “representative body” of the former and a trusted partner of the later institutions. These cooperative relationships enable UNIFE to ensure that the results of relevant projects are known by these important regulation and standardisation bodies.

UNIFE Research & Innovation Committee:

The UNIFE Research & Innovation Committee steers the association's technical activities pertaining to the European research framework. The committee is actively defining the rail supply industry's EU level R&I priorities and monitoring progress made at Europe's Rail, Horizon Europe and ERRAC. This committee is composed of technical directors from UNIFE's system integrators and subsystem suppliers.



A woman with blonde hair tied back, wearing clear safety goggles with red straps and a blue work jacket, is focused on her work in a workshop. She is positioned in front of a blue bench vice. The background is slightly blurred, showing a workshop environment with a white wall and a black knob in the upper right corner.

Horizon Europe, Europe's Rail Joint Undertaking

and other opportunities

Europe's Rail Joint Undertaking

Europe's Rail is the second large-scale European rail research joint undertaking to seek to focus research efforts and accelerate the creation of market-driven solutions by integrating new and advanced technologies into novel innovative rail solutions. The joint undertaking will support the development of a strong and globally competitive European rail industry by contributing to the achievement of the **Single European Railway Area** (SERA).

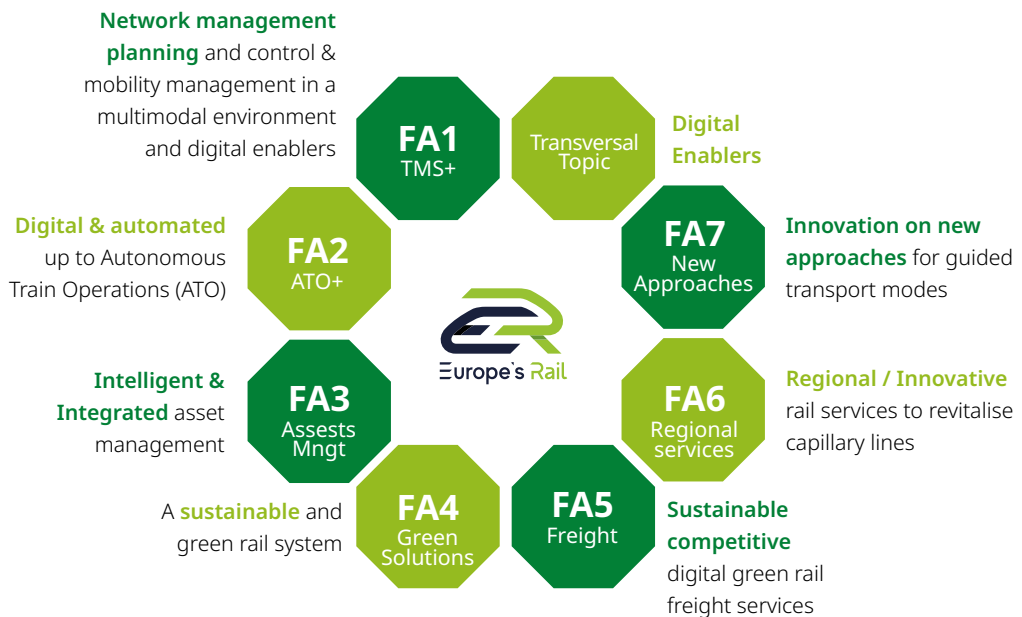
The Europe's Rail Joint Undertaking's objective is to deliver a high capacity, integrated European railway network by eliminating barriers to interoperability and providing solutions for full integration, covering traffic management, vehicles, infrastructure and services. The aim is to achieve quicker market uptake and deployment of projects and innovations originated in the programme. Exploiting these deliverables has huge potential for digitalisation and automation that will reduce costs, increase capacity and enhance flexibility and reliability across the rail sector.

Research and innovation initiatives conducted by Europe's Rail seek to achieve the project's overall objectives by working on new technologies that will be tested and applied across the entire rail system. To achieve such system-wide developments, the Joint Undertaking's work is structured into two distinct pillars: **The Innovation Pillar** and the **System Pillar**.

Europe's Rail offers all interested stakeholder – both members and those not officially affiliated with the Joint Undertaking - the opportunity to participate in regular and competitive Open Calls. Their purpose is to contribute to the work planned in the Europe's Rail Multi Annual Work Programme and deliver new technologies, solutions and services.

Innovation Pillar

The Innovation Pillar steers the Joint Undertaking's R&I activities and is organised into 7 Flagship Areas:





System Pillar

The System Pillar aims to deliver a unified operational concept and a functional, safe and secure system architecture. Its architects have designed the pillar with due consideration paid to cybersecurity aspects. They also placed focus 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 to ensure that research targets both commonly agreed upon and shared customer requirements and operational needs. The programme has also positioned itself to be open to evolution.

It is organised into two “Tasks”: **EU Rail System** and **CCS+**.

Members

Europe's Rail is composed of 25 Members and the European Union.
EU-Rail's membership includes:

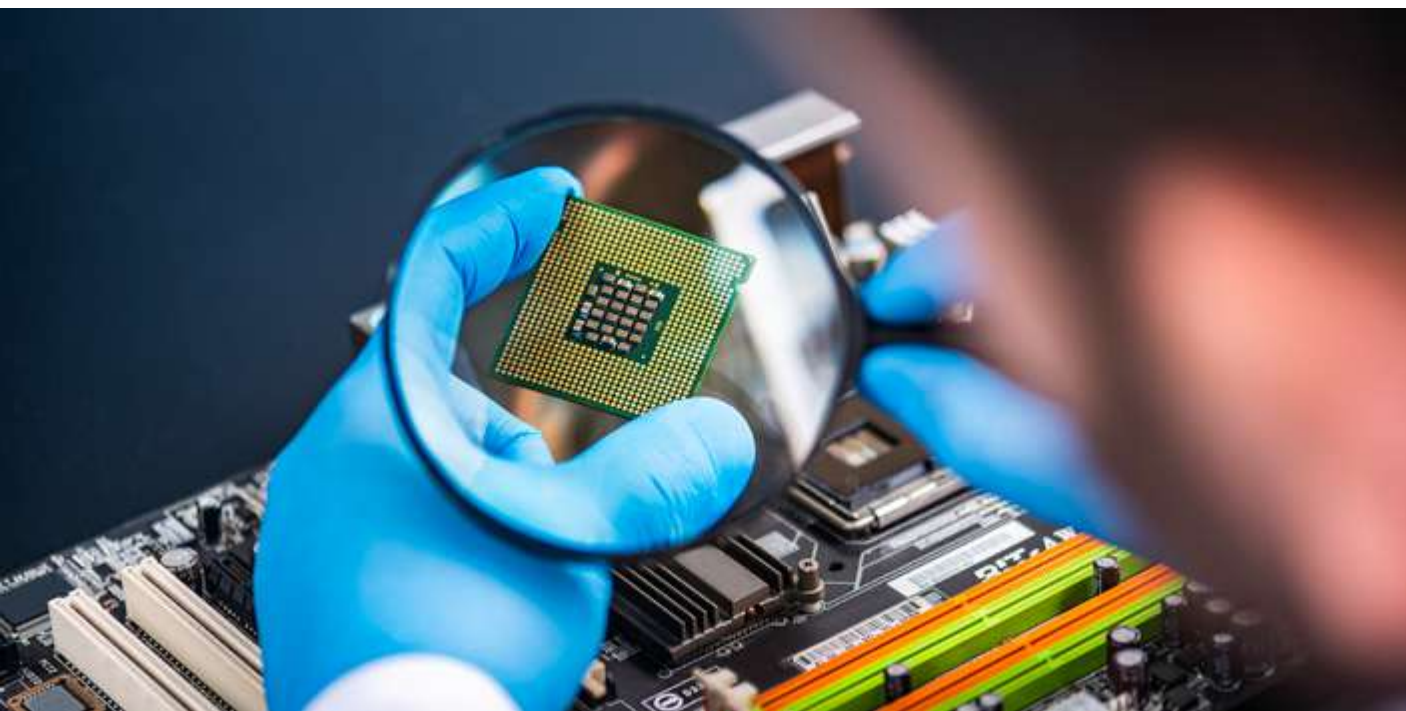


Other Horizon Europe opportunities

Outside of Horizon Europe's Joint Undertakings, the European Commission adopts a new work programme every second year. These agendas outline updated objectives and specific topic areas that will receive European funding.

UNIFE regularly informs its members about calls opportunities that emerge from these developments - especially ones created under Horizon Europe's Cluster n°5 on "Climate, Energy and Mobility".

Thanks to the interest of UNIFE members, our association assesses multiple, concurrent possibilities with various stakeholders to prepare proposals in different fields of expertise ranging from cybersecurity and satellite positioning to telecommunications and batteries.







UNIFE

R&I services for its members

Joining UNIFE will help your company

- ▶ **Actively contribute** to the rail system's evolution and accelerate its digitalisation
- ▶ **Get the inside track** on Europe's Rail Joint Undertaking and Horizon Europe, including advance notifications on how they plan to support the development of emerging rail technologies
- ▶ **Be supported** in the bid management activities, such as monitoring funding opportunities and offer preparation
- ▶ **Join EU-funded research** projects that contribute to the technical harmonisation of railway systems

As the association is representing the European rail supply industry, UNIFE is proactively involved in Horizon Europe - including Europe's Rail - Open Calls and supports its members by playing three crucial roles in this process:

Info-Point	Facilitator	Coordinator
<ul style="list-style-type: none"> ▶ UNIFE ensures the active involvement of its members in Horizon Europe Open Calls, strengthening the supply industry's role in the development of rail transport. 	<ul style="list-style-type: none"> ▶ Draw from its significant experience in European research and its robust stakeholder network that includes Operators, Infrastructure Managers, Industry, Academia, research Institutes, ERRAC and more. 	<ul style="list-style-type: none"> ▶ UNIFE directly participates in relevant Open Calls - either as a coordinator or a partner - to promote the involvement of its members and advance their interests.
<ul style="list-style-type: none"> ▶ We encourage our members' participation by offering a platform for discussion and information exchange to inform the preparation of their proposals. 	<ul style="list-style-type: none"> ▶ UNIFE facilitates communication and the creation of work channels between its members and external stakeholders interested in the Open Calls. 	<ul style="list-style-type: none"> ▶ As a coordinator, UNIFE is responsible for the preparation and submission of proposals with the support of the consortia's partners.
<ul style="list-style-type: none"> ▶ Our association provides its members with general information (ex. financial, administrative, etc.) to support them during the Open Calls' preparatory phase. 	<ul style="list-style-type: none"> ▶ On its members' behalf, UNIFE collaborates with other key European rail sector actors on joint proposals. 	<ul style="list-style-type: none"> ▶ As a partner, UNIFE contributes to the preparation of proposals by providing its extensive expertise.



Research & Innovation Projects



DAYDREAMS

DAYDREAMS (Development of prescriptive analytics based on artificial intelligence for IAMS) is a project within Shift2Rail's *3rd Innovation Programme* (IP3). It started its activities in December 2020.

DAYDREAMS's overall objective is to advance - in line with S2R JU's vision - on the integration and use of data and artificial/human trustworthy intelligence, together with context-driven **Human Machine Interface** (HMI) for prescriptive **Intelligent Asset Management Systems** (IAMS) in railway by:

- ▶ Advancing the maintenance approach by moving from preventive and predictive asset management towards prescriptive asset management
- ▶ Largely improving the decision-making process by developing multi-objective decision optimisation approaches that take into account all possible, and often conflicting, implications of IAMS decisions in the railway environment (e.g., on Traffic Management System, Energy, Freight, etc.,)

- Reinforcing the role of the person-in-the-loop by designing and developing advanced context-driven HMIs to allow context- and risk-aware multiple-options decision-making processes supported by the information on data sensitivity and robustness. The HMI will allow the person-in-the-loop to:
 - Properly access and visualise predictions/ metrics and models
 - Assess why and how the model predicts something (“opening the black-box”)
 - Steer models by setting parameters
 - Evaluate alternatives using parameter steering and extend this process through speculative execution

While previous projects involving DAYDREAMS partners, such as [IN2RAIL](#) and [IN2DREAMS](#), have successfully addressed condition-based and predictive maintenance approaches that improved traditional reactive and preventive maintenance methodologies, DAYDREAMS will exploit state-of-the-art technologies to tackle complexity and exploit the business value of prescriptive approaches already used in other industrial fields. DAYDREAMS will also increase trust by utilising blockchain and smart technologies inherited from IN2DREAMS to track and monitor the IAMS adoption and use in multi actors’ environments.

Read more about this important project at daydreams-project.eu

Want to know more about DAYDREAMS? Please contact UNIFE Technical Affairs Manager Stefanos Gogos at stefanos.gogos@unife.org.



GATE4RAIL

GATE4RAIL (GNSS automated virtualized test environment for rail) was a project within S2R JU's *2nd Innovation Programme* (IP2) that ended in February 2021.

GATE4RAIL aimed to define, design and develop a geo-distributed simulation and verification infrastructure to evaluate the GNSS performances in the railway environment. GATE4RAIL also identified methodologies and tools aimed at simulating GNSS behaviour in different railway scenarios and situations and automated updating of tests environment.

The project's Final Conference and Demonstration took place on 22 February 2021. During the latter, project partners showcased main functionalities and capabilities of both the geo-distributed simulation and verification infrastructure. They also presented the results of the test campaign.

Final achievements and results are summarised as follow:

- A simulation and verification platform for the evaluation of the GNSS performances in the railway environment had been designed, developed and tested. A set of users, functional, system and operational requirements were identified as the foundation

For more information
about GATE4RAIL, please
visit gate4rail.eu

**If you wish for further
insights**, please contact
UNIFE Technical Affairs
Manager Jose Bertolín at
jose.bertolin@unife.org.



for the definition and implementation of the GATE4RAIL system level architecture (SLA).

- The consortium performed an investigation, selection and test of different methodologies for automated update of test environment. **ARCADIA/CAPELLA** was selected as the best Model Based Systems Engineering approach for the project.
- The partners also performed an investigation, selection and test of concepts and methodologies definition for continuous integration, automated test and repetition and evaluation. **GitLAB** impressed the evaluators, who elected it the best approach in terms of continuous integration for the project.

GEARBODIES

The **GEARBODIES** project, which started in December 2020, seeks to develop new methods and technology for the inspection of new materials in carbody applications, as well as to employ innovative approaches for developing novel concepts with enhanced lifetimes for key running gear components.

GEARBODIES is working towards the development of cost-efficient and reliable trains by contributing

with specific innovations towards the Shift2Rail Technology Demonstrators (TD) of *Innovation Programme 1* (IP1), through two dedicated work streams:

- ▶ Work Stream 1 (WS1): Inspection methods for carbodies using new materials (TD1.3) to develop effective and affordable solutions for inspecting carbodies that are using new lightweight materials
- ▶ Work Stream 2 (WS2): Innovative approaches for developing running gear components (TD1.4), which aim to employ innovative approaches, tools and methods for developing novel concept designs of running gear components with extended lifetime, and low LCC, whilst maintaining or reducing current levels of reliability, noise emissions, and track damage.

Interested in this research and want to hear more, please visit gearbodies.eu.

For more information about this project's status, please contact UNIFE Technical Affairs Manager Stefanos Gogos at stefanos.gogos@unife.org.

Through these efforts, GEARBODIES will actively contribute to improving the efficiency, safety and competitiveness of the European railway sector by supporting the implementation and exploitation of innovative materials and practices. It will have profound impacts on the cost efficiency and reliability of the sector, as well as on its energy consumption and infrastructure maintenance. Inspection time will be significantly reduced, while the use of new materials and systems will extend component lifetimes and lower maintenance costs.



IN2ZONE

IN2ZONE (The next generation of railway transition zones) is a Shift2Rail *Innovation Programme 3* (IP3) project that seeks to enable infrastructure to boost the economic viability, sustainability and resilience of the European rail network.

IN2ZONE's objective is to design and test a prototype next generation transition zone solution that provides a step-change in track support conditions, resulting in a drastic reduction in maintenance interventions. It plans on doing so by:

- ▶ Reducing in-service affecting delays due to fewer track geometry defects and associated failures (for example, due to track settlement or a localised loss of rail support)
- ▶ Increasing network capacity in terms of more frequent trains and higher speeds, due to improved vertical geometry and reduced degradation rate
- ▶ Reducing lifecycle costs through the reduction of maintenance, extending the operational life of both the track and its associated assets
- ▶ Lowering noise and vibration at the transition locations, by providing a sustained smooth transfer between areas of differing support stiffness

For more information, please visit the project's website at in2zone.eu

To get further updates concerning IN2ZONE, please contact UNIFE Technical Affairs Manager Marta García via email at marta.garcia@unife.org.

- Providing a solution for optimum and sustained track support conditions that is compatible with the next generation track solutions already developed

Consequently, the project will enable the transition zone solution to selfcorrect minor vertical track geometry irregularities or faults. Further, the solution architecture will be modular to ensure the benefits are realised in minimal time.

During 2021, the current state-of-art technology and identification of innovative concepts for transition zones have been defined and the technical specifications for the design of transition zones have been prepared.



IP4MaaS

IP4MAAS is a project under S2R JU's *4th Innovation Programme* (IP4). The project was launched in December 2020.

Within IP4, more than 10 projects have created a wide array of technologies which tackle various aspects of the traveller experience. Those technologies tackle the interoperability of **Transport Service Providers'** (TSPs) services, travel shopping, booking & ticketing, trip tracking, travel companion technologies and business analytics. Various tools have been tested in multiple

locations around Europe to retrieve user feedback and improve upon those critiques. Today, IP4 has a large toolset of proven technologies that need to go to the next level and be implemented in large scale products.

To that end, IP4MAAS will assist IP4 projects in demonstrating the technologies at an unprecedented level, at 6 different locations in Europe and with the cooperation of more than 10 transport operators (Public Transport and Mobility-as-a-Service), authorities and agencies. IP4MaaS will develop the scenarios for the demonstrations and a thorough assessment strategy that evaluates both the performance and impact of the technologies on users and the environment in urban and suburban setups. IP-4MaaS will also create strategic plans for the demonstrations that will be updated in two iterations, leading to two demonstration phases.

For more information
on IP4MAAS, please visit
ip4maas.eu

To get updates on these
demonstrations, please
contact UNIFE Technical
Affairs Manager Stefanos
Gogos via email at stefanos.gogos@unife.

Furthermore, the project will provide recommendations on the promotion and transferability of the technologies to other locations in Europe. IP4MAAS will organise and monitor one of the largest demonstrations of technologies in the history of European research and innovation project's and expects its findings to be used as a baseline for future demonstrations and testing that involves a diverse group of demo partners.



NEXTGEAR

NEXTGEAR (Next generation methods, concepts and solutions for the design of robust and sustainable running gear) is a Shift2Rail *Innovation Programme 1* (IP1), which saw its activities commence in December 2019.

The project contributes to the development of a new generation of running gear. To make a step change towards this end, NEXTGEAR is:

- ▶ Updating the **Universal Cost Model** (UCM) developed by the Roll2Rail project
- ▶ Suggesting new ideas on the use of new materials and manufacturing methods
- ▶ Designing the wheelset of the future by proposing hybrid carbon fibre/metallic wheelset design

Since NEXTGEAR got underway, some of its preliminary achievements and results include:

- ▶ As the project aims to release the UCM 2.0 tool release by its conclusion, the previous version has been upgraded with the development and improvement of new modeling techniques, cost modelling methods and new user interface
- ▶ NEXTGEAR has investigated two novel materials and manufacturing methods: the

additive manufactured (AM) components and fibre reinforced plastic (FRP) based components. Two metro vehicle running gear components have been designed, manufactured and tested obtaining a significant mass and production time reduction

- ▶ A high safety integrity level (SIL4) controller has been designed, manufactured and tested in realistic “Hardware in the Loop” conditions, following the requirements consolidated through a systematic study of active suspension systems
- ▶ Hybrid metallic-composite (HMC) axel has been designed with a significant mass reduction, after evaluating the feasibility of using composite materials for the construction of HMC wheelset. Manufacturing and mechanical parameters were simulated and analysed not only to choose the best candidate of the three proposed concepts but also to complete its characterization.

Interested in NEXTGEAR?
Visit the project website at
nextgear-project.eu

Looking to discuss
NEXTGEAR? Please contact
UNIFE Technical Affairs
Manager Jose Bertolín at
jose.bertolin@unife.org.



OPTIMA

OPTIMA (Communication platform for traffic management demonstrator) is a Shift2Rail Innovation Programme 2 (IP2) project began its work in December 2019.

OPTIMA will address the design and development of a Communication Platform to manage the link with different services, or “multimodal operational systems”, supporting Traffic Management System (TMS) applications.

The platform will link TMS applications with Traffic Management, Traffic Control, Maintenance/Energy Management and signalling field infrastructure systems.

The main objectives of OPTIMA are:

- ▶ Make use of the Integration Layer to integrate real-time data from the rail business service, external sources, services running in the Application Framework and operator workstations
- ▶ Develop, validate and verify the Communication Platform
- ▶ Provision of a fully available and documented communication platform for installing and testing complementary projects prototypesIn 2021, the project began in its development

Become better acquainted
with this project by visiting
its dedicated website:
optima-project.eu

For more information
about OPTIMA, please
contact UNIFE Technical
Affairs Manager Jose
Bertolín at jose.bertolin@unife.org.

phase and has since entered the validation stage. The consortium has worked on the development of the Communication Platform modules, which are scheduled to be finalised in early 2022. The consortium has implemented and will continue to work on defining the *Business Services*, the platform persistence layer and the interfaces based on the outcomes of the **Common Data Model** (CDM) activity. The integration Layer is already available and deployed on the validation platform.

A strong collaboration with complementary Shift2Rail projects [X2Rail-4](#) and [FINE-2](#) has been established, particularly for activities concerning the CDM and integration of the TMS applications into the platform. This relationship ensures their alignment and the success of future development.





RAILGAP

RAILGAP (Railway ground truth and digital map) is a **Horizon 2020** project that started in January 2021. It is tasked with developing innovative **High Accuracy, High Precision Ground Truth and Digital Maps**, essential elements of an EGNSS train positioning system and a Validation & Verification Environment.

During the project's first year, the consortium was dedicated to analysing user needs and sorting them into functional and non-functional requirements for the development of the Ground Truth and Digital maps.

Additionally, the project started to prepare the measurement campaign through the review of the state-of-the-art of selected technologies and the definition of the measurement procedures. The work related to the characterisation of technologies in railways also started. It was mainly focused on the obtention and validation of the necessary error models and the performance of sensor fusion solutions for railway precise and robust position/trajectory determination.

To learn about train positioning initiatives, visit railgap.eu

Want to hear more about mapping? Please write to UNIFE Technical Affairs Manager Jose Bertolín at jose.bertolin@unife.org.



RECET4Rail

RECET4Rail (Reliable energy and cost-efficient traction system for railway) is a project under S2R JU's *1st Innovation Programme* (IP1).

The RECET4Rail research project is meant to introduce new emerging and disruptive technologies to rail traction systems in order to improve the overall rail system performance from all points of view, while reducing the overall lifecycle exploitation cost.

Its ambition is to provide essential knowledge and competence that can lead to the improvement to high Technology Readiness Levels (TRL) of Shift2Rail traction demonstrations developed in the Shift2Rail **PINTA-3** project. This collaboration paves the way for future key developments in digitalisation applied to traction, environmental sustainability (especially devising carbon-free traction systems) and reinforcement of standardisation to lower complexity and costs.

Four workstreams are envisaged within the project:

- ▶ 3D additive manufacturing and new manufacturing technologies
- ▶ Wireless Dynamic Charging for urban vehicles based on silicon carbide (SiC) semiconductors and high power lithium ion batteries sizing

Visit the project's website, recet4rail.eu, for more details.

For further inquiries, contact UNIFE Technical Affairs Manager Marta García by email at marta.garcia@unife.org.

- Investigations on reliability of traction components and lifetime mechanisms
- Big Data, Artificial Intelligence (AI) for smart and predictive maintenance of traction systems

This year, RECET4Rail has already reached important research conclusions in 3D printing technologies for traction components with the selection of one use case. Also, in relation with Wireless Dynamic Charging for urban vehicles, a set of solutions based on lithium batteries for a free catenary operation of a tramway in a city profile have been already defined.



RIDE2RAIL

RIDE2RAIL is a project directly linked to S2R JU's *4th Innovation Programme* (IP4). The project started in December 2019 and works to develop solutions and tools that will facilitate the efficient combination of ride-sharing and scheduled transport services - for example, bus and rail. By making it easier to compare and choose between multiple transport options and services, RIDE2RAIL seeks to make ride-sharing a (more) attractive way to move passengers towards public transportation while fighting both congestion and pollution.

RIDE2RAIL aims to integrate multiple public, private and social data sets and sources with

existing transport platforms to promote effective ride sharing practices by citizens. This will make rail a complementary transport mode that extends public transport and railway networks. The RIDE2RAIL framework for intelligent mobility will integrate and harmonise real-time and diverse information about rail, public transport, ride-sharing and crowdsourcing in a social ecosystem, which will permit users to compare and choose between multiple options or services classified by a set of criteria – including environmental impact, travel time, comfort, cost – according to their preferences. The hope is that this will make the travel experience both more positive for individual users and, globally, more sustainable.

RIDE2RAIL will design, develop and test in real demonstrators a set of software components for the IP4 ecosystem, including advanced Travel Companion features and a crowd-based Transport Service Provider, which will foster the combination of flexible and regular multimodal mobility through an easy personalisation in diverse existing environments, facilitating market uptake. It will also deliver a set of validated proof of concepts and business cases envisaging future mobility scenarios where advanced transport solutions will be seamlessly integrated into existing collective transport services (rail and others) in four diverse European cities: Padua, Athens, Brno and Helsinki. Its first pilot, the robot bus service in Helsinki's Vuosaari district, has been initiated and is the first of two pilots planned in the area. Both are focused on reducing single-occupant private car trips.

Learn more about the future of multimodality by visiting RIDE2RAIL's website: ride2rail.eu

You can also direct any questions to UNIFE Technical Affairs Manager Stefanos Gogos by writing him at stefanos.gogos@unife.org.



SAFE4RAIL-3

Safe4Rail-3 (Advanced safety architecture and components for next generation TCMS in railways) is a Shift2Rail IP1 research project that seek, in collaboration with the Shift2Rail **CONNECTA-3** project, to increase the flexibility and reliability of the **Train Control and Monitoring System** (TCMS) communications. It is also tasked with reducing development and maintenance costs and achieving novel train functionalities. The project will do so while paying special attention to manufacturer interoperability and the availability of multiple sources.

Safe4Rail-3's activities are based on the development of **three technological pillars** aimed at advancing the maturity of technologies and devices for the next generation of TCMS needed to achieve TRL 6/7:

- ▶ Development of the **Drive-by-Data** (DbD) devices in the train network
- ▶ Development of high TRL wireless devices and antennas that are suitable for Wireless Train Backbone and Consists domains (Wireless TCMS), along with analysis of antenna installation
- ▶ Integration of a Heating, Ventilation and Air Conditioning (HVAC) functionality on top of a Functional Distribution Framework platform

and a DbD communication layer that takes full advantage of the expertise obtained from **AUTOSAR**

To read more about this project visit its website: safe4rail-3.eu

Additionally, please contact UNIFE Technical Affairs Manager Jose Bertolín at jose.bertolin@unife.org for further details.

Safety and Security assessments for these technological developments will be analysed and studied based on the upcoming standardisation.

During the first year of the project, the consortium, in collaboration with the complementary CONNECTA-3 project, worked to consolidate the new requirements for the three technologies to achieve TRL 6/7 and started the development phase.



SILVARSTAR

SILVARSTAR (Soil vibration and auralisation software tools for application in railways) is a 2-year collaborative project that fits into the "Cross-Cutting Activities" category of Shift2Rail.

This project seeks to provide the railway community with software tools and methodologies best suited to assessing the noise and vibration environmental impact of railway traffic on a system level.

The project's main ambition is to prove software tools for application in soil vibration and in auralisation

within the railway sector. In this context, **the project has two work streams** which address these challenges:

- ▶ The **first work stream** is focused on the prediction of ground vibration through the development and validation of a hybrid (numerical and experimental) approach.
- ▶ In the **second work stream**, auralisation and visualisation software tools will be developed based on a physics-based model to synthesize railway noise in high quality.

For more information, please visit the project website silvarstar.eu

For further details on SILVARSTAR, contact UNIFE Technical Affairs Manager Marta García by email at marta.garcia@unife.org.

This year, different advancements in the project have been achieved: the research and definition of the state-of-the-art for prediction models for railway induced vibration, definition of the concept and the framework for the vibration prediction tool that can be used for environmental vibration impact assessment of new and upgraded railway lines. Furthermore, related with the second work stream a technical demonstration on virtual reality have been performed at the **Swiss Federal Laboratories for Materials Science and Technology** in November 2021.



STREAM

STREAM (Smart tools for railway work safety and performance improvement) is a S2R JU IP3 project dedicated to delivering a resilient, consistent, cost-efficient and high capacity European rail infrastructure.

The project's activities are focused on delivering two methods – or Work Streams - to improve competitiveness in railway maintenance and construction operations:

- ▶ The **first work stream** involves the development of a control platform designed to convert traditional heavy-duty hydraulic machines (e.g., excavators) in robotic systems.
- ▶ The project's **second work stream** is focused on creating a modular, wearable, active exoskeleton to reduce the risk of injury due to physical overload.

Furthermore, STREAM has set up an **End-User Board** composed of 12 companies. These board members represent end users of the technology, including Infrastructure Managers and Construction companies.

They provide feedback on all technical aspects of the outputs to help bring the technology close to the market needs. Two meetings have been held and resulted in fruitful exchanges of information.

For more information,
please visit the project
website at streams2r.eu

To have even more details,
please contact UNIFE
Technical Affairs Marta García
by email at marta.garcia@unife.org



In 2021, the main project objectives have been:

- ▶ **Definition of the technical requirements**, categorised by user, safety, regulatory, and ethical requirements for each of the two technical solutions. Those include the analysis of the replies of the questionnaires for companies and workers.
- ▶ **Technical demonstrations** of both technologies in Italy and Spain at the beginning of the year.
- ▶ **Cost-Benefit Analysis** and ethical assessment are highly relevant to the project. During the year several research activities have been conducted to improve the background within this field.

TRANSIT

TRANSIT (Train pass-by noise source characterization and separation tools for cost-effective vehicle certification) is a research and innovation project being conducted within the wider S2R JU's "Cross-Cutting Activities".

TRANSIT will provide the railway community with a proven set of innovative tools and methodologies for reducing rail's environmental impact and improving the level of interior acoustic comfort of railway vehicles. Currently, vehicle certification and homologation requires extensive measurement

campaigns on dedicated test tracks, leading to high cost and time expenses. In the future, conducting these processes virtually should reduce these expenditures. Furthermore, increasing energy efficiency of railway transport is a key goal of Shift2Rail and efforts are ongoing to reduce vehicle weight. This is being achieved, for example, by applying composite material technology in the design of the carbody.

The project is developing accurate and robust source characterisation, separation methods and techniques, and exterior noise simulation tools to facilitate virtual testing and more cost-effective vehicle certification and homologation methods. Regarding interior acoustic comfort, innovative material designs needed to increase sound transmission loss and absorption are being developed. Their creation and deployment will lead to improved interior sound quality while not exceeding weight constraints.

Throughout 2021, different measurement campaigns were carried out. They are requisite to reaching the project's expected outcomes.

For more information

please visit the project website at transit-prj.eu

Interested in noise and vibrations? Please contact UNIFE Technical Affairs Manager Marta García by email at marta.garcia@unife.org.



5GRAIL

5GRAIL is a Horizon 2020 EU-funded project that consists of eight Work Packages and was organised to validate the **first Future Railways Mobile Communication System** (FRMCS) – the successor to **Global System for Mobile Communications – Railway** (GSM-R) - specifications by developing and testing prototypes for the technology's ecosystem on both trackside infrastructure and on-board use. Regarding the latter, the project aims to reduce specific equipment costs and installation engineering time by combining all train-to-ground communications. The hypothesis is that this is possible by enabling a modular on-board setup based on standardised interfaces and including mainstream 5G components, called **Telecom On-Board Architecture** (TOBA), in alignment with the sector's technical vision.

The project has started to define the functional tests and will then work towards prototypes development and evaluation, for both on-board and infrastructure, including the **European Train Control System** (ETCS), **Automatic Train Operation** (ATO), FRMCS voice specific services and **Train Control and Monitoring System** (TCMS) applications. The objective is to create interfaces between TOBA and ETCS, ATO and TCMS.

Want to find out more about the future of rail telecommunications? Visit 5GRAIL's project website at 5grail.eu

If you require further information, reach out to UNIFE Technical Affairs Manager Stefanos Gogos at stefanos.gogos@unife.org.

Prototypes will be tested in simulated and real environments with pilots in both labs and the field. These experiments will be conducted in sites across Europe – namely, **France, Hungary** and **Germany** - to ensure compliance and validation for specification, standards and performance. Consequently, these experiments will guarantee the time to market for FRMCS products, which are planned to be available in 2025 as per the European timeline.

UNIFE is leading the project's Dissemination, Communication and Exploitation Work Package. This project is also linked to the UNIFE **UNITEL** committee, which is involved in FRMCS' development.

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