

Shift2Rail

CATALOGUE OF SOLUTIONS



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Director-General for Mobility and Transport, Henrik Hololei:

“

The rail research and innovation activities under Shift2Rail are starting to deliver concrete results, bringing us one step closer to a railway system that is more attractive for passengers and businesses, competitive, efficient and flexible. Shift2Rail plays a pivotal role in unlocking the hidden potential of rail and making our overall transport system more sustainable.

”

Bringing you the rail solutions of the future



“ We are delighted to make available for the first time a Catalogue of Solutions, which we intend to update annually, bringing together the innovative solutions Shift2Rail Members together with other key stakeholders have been working on to deliver transformed rail systems. ”

Carlo Borghini
Executive Director,
Shift2Rail Joint Undertaking

This first 2019 edition of Shift2Rail's Catalogue of Solutions illustrates successful R&I results in the form of possible products and solutions including delivery dates, while highlighting the benefits for final users, operators, infrastructure managers and/or suppliers. The advantages of integrating demonstrators into market solutions so that they can deliver the rail Innovation Capabilities of the future are outlined.

The InnoTrans event in 2018 marked a turning point for the Shift2Rail Joint Undertaking showing its capability to deliver tangible innovative solutions answering to the evolving needs of rail stakeholders. Game-changing demonstrators were showcased including virtually connected trams, noise and vibration monitoring and mitigating technologies, smart energy metering, passenger ticketing and travel companion, intelligent video gate and digital brake test for freight trains, all of which received a lot of attention and coverage during and after the event. These demonstrators mark a key moment in the ongoing work being performed by Shift2Rail Members and beneficiaries to transform the rail system with these innovative solutions expected to be industrialized and ready for market uptake from 2022. It is these solutions which are at the heart of this catalogue.

In cooperation with its Members, Shift2Rail continues to progress towards its goals that contribute to a sustainable, punctual, interoperable, high-capacity rail system, providing a backbone for the whole mobility and transport sector in Europe. Together with its Members Shift2Rail has invested more than € 600 million in three years in rail R&I activities. This by itself is a major achievement as it represents a significant increase in the efforts to innovate the sector as a whole.

The catalogue highlights what will be available in the market as stand-alone or integrated products, and provides a first glimpse of what the investment of the European Union together with the rail sector stakeholders is capable of materializing, bringing benefits to people and freight businesses.

Much has been achieved, but there is still a lot to be done. We look forward to continuing our work and to presenting the solutions one step closer to market uptake at InnoTrans 2020. It is on this occasion that we will have the pleasure to launch the next edition of Shift2Rail's Catalogue of Solutions.

Shift2Rail and its innovative programme

The Shift2Rail Joint Undertaking (S2R JU) ¹ is a public-private partnership under the Horizon 2020 Framework Programme established to manage and coordinate mission oriented Research and Innovation (R&I) activities for a major transformation in rail systems in Europe.

Shift2Rail's vision is to deliver the most sustainable, cost-efficient, high-performing, time-driven, digital and competitive customer-centred transport mode for Europe. We do this through research and innovation, which develops cutting-edge innovative solutions to create railway systems of the future for passengers and freight. This is made possible thanks to our members and stakeholders, including SMEs and research institutions, working together across Europe. Shift2Rail fosters the introduction of better trains to the market which can reliably operate on an innovative rail network infrastructure at a lower life-cycle cost, with more capacity to cope with growing passenger and freight mobility demand. Shift2Rail Research and Innovation (R&I) activities

¹ The S2R JU was officially established on 7 July 2014, following the adoption of Council Regulation (EU) No 642/2014 of 16 June 2014 establishing the Shift2Rail Joint Undertaking (S2R Regulation).



are committed to contributing to the achievement of the Single European Railway Area (SERA).

The S2R Programme is an integrated set of R&I activities, structured around five asset-specific Innovation Programmes (IPs), covering key structural (technical) and functional (process) subsystems of the rail systems: passenger trains, traffic management systems, infrastructure, IT services and freight trains.

Additionally, cross-cutting activities (CCA), such as research on long-term economic and societal trends in customer needs and human capital and skills, offer information on the market to the different IPs, making sure that R&I activities are up to date and serve the needs of the European citizens.

Within each IP and the CCA, researchers are developing 54 innovative technologies and solutions, which are illustrated in this catalogue.

A System of Systems' Architecture: Innovative Solutions for Railway Next Generation Systems

Together with the sector, Shift2Rail will deliver under the European Commission's DG MOVE and together with the European Union Agency for Railways, a Comprehensive System of Systems' Architecture. This entails a structure of components, their relationship, and the principles and guidelines governing the design of their functional evolution over time:

- ▶ Integration of the S2R Innovative Solutions for the ERTMS Game Changers (*ATO GoA2, GoA3/4, Adaptable Communication System, Moving Block, Train Positioning*) together with sectorial initiatives (*RCA, OCORA*) for an Open System Interface (or interconnection) model
- ▶ Integration of S2R interoperable solutions as *Intelligent Mobility Management (enlarged TMS), next gen TCMS, smart connected object controllers, condition based maintenance* for all kind of assets, etc.
- ▶ Aligning all ongoing modelling initiatives (RTM, EULynx, IFC, RailML, TAP/TAF; SensorML etc.) in terms of principles and digital data exchange format with the S2R solution on a EU shared Conceptual Data Model

Innovation Capabilities delivered through our solutions

To realise Shift2Rail's vision, the railway needs to put in place a range of new Innovation Capabilities. These will enable the sector to produce value-added products and services.



1. Automated train Operation

Trains are able to operate themselves and run closer together based on an automated train operation system, boosting the capacity significantly on existing lines. Autonomous and remote controls provide a safe operation. Rail operations are partly or fully automated.



2. Mobility as a Service

Customer demand-driven services lead the railways to provide excellent service within the overall mobility chain. Connections between the railways and the other modes are seamless, making mode interchange as simple and as efficient as possible. Information is permanently available to make travel safe and efficient along the travel chain including at stations. All customers and potential customers are connected to mobility services.



3. Logistics on demand

Logistic services are driven by customer demand, with freight moved reliably in flexible units designed to carry various loads. Better planning, tracking and shipment information capabilities combine to offer customers flexibility and capacity at reasonable, attractive prices. The rail system is fully integrated with the multimodal logistic chain.



4. More value from data

To deliver on all the capabilities, rail manages a growing volume of data contributing to the data economy. Collection, analysis, interpretation and prediction are automated to provide consistent up-to-date information supporting fast, well-informed decisions and business benefits. This is achieved through a robust, resilient and secure information architecture and governance structure. Taking into account data privacy management, relevant information is shared across the industry and more widely, enabling the development of new services and applications to the benefit of the railway and its customers.



5. Optimum energy use

Railways maintain their position as the most environmentally friendly mode of transport by decreasing energy consumption. This is achieved together with lowered operating costs through the use of an intelligent energy management system. The introduction of new technologies and methods as supporting tools enable reduced and optimised demand-led energy use and energy efficiency.



6. Service timed to the second

Situational awareness, where each train's location and speed is known at all times and in real-time, supports service operation timed to the second. This results in increased and enhanced operational flexibility and contributes to a more robust, resilient, and reliable service as well as faster recovery from service disruption.



7. Low cost railway

New models to deliver efficient and affordable infrastructure, rolling stock and railway operation allow the rail mode to be viable in areas of low demand and to compete for new transport links. Design, service solutions, technologies draw inspiration from other sectors such as light rail, automotive and aviation. .



8. Guaranteed asset health and availability

Optimised maintenance keeps the railway continuously open, fostering minimal disruption to train services. Shared realtime monitoring of asset health by a wide array of sensors connected together in an Internet of Things (IoT) environment feed the predictive maintenance decision-making process. Asset health and availability is further improved by machine learning, artificial intelligence and big data analytics. Robust modular units and infrastructure are easily maintained and repaired through an automated system, making the operation punctual, safe, and quick.



9. Intelligent trains

Intelligent trains are aware of themselves, their passengers/ loads, and their surroundings, knowing where they need to be and when, and are able to automatically adjust journeys to meet demand. In addition, they intelligently feed information of infrastructure to support preventive maintenance. A network of fully intelligent trains can be self-regulating, negotiating vehicle to vehicle to resolve movement authorities and potential conflicts at junctions in the network and react to unexpected situations. The trains are also aware of and able to take account of the status of other transport modes.



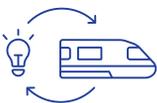
10. Stations and “smart” city mobility

Rail is the backbone of urban mobility — with stations at the heart of ‘smart’ cities — being places to work, live, meet, and communicate, and where individual transport modes, including public transport and long-distance rail transport, are physically connected. New and modernised station designs provide easy access and seamless interchange between the transport modes, enabling railways to manage growing passenger volumes and mobility demands.



11. Environmental and social sustainability

Railways continue to deliver sustainable transport solutions as overall travel demand intensifies. Rail makes an increased contribution to the transport economic mix, decoupling environmental harm from transport growth. Railways are able to operate with minimal environmental impact and with a low carbon footprint. Inclusive and easy access is available for all citizens to railway facilities, products, and services.



12. Rapid and reliable R&I delivery

An ecosystem for R&I based on effective collaboration, the provision of greater technology demonstration capability, and the rapid integration of technology into the railways, moves barriers to the adoption of new technologies and decreases time to market.

What is the purpose of this Catalogue of Solutions?

This catalogue illustrates what R&I investments generate as innovative solutions for market uptake. The purpose is to:

- ▶ **Explain successful results in terms of possible products and solutions** with a clear timetable
- ▶ **Show Benefits for “customers”**: final users, operators, infrastructure managers and/or suppliers
- ▶ **Highlight the advantages** of integrating the demonstrators into market solutions
- ▶ Illustrate how the solutions will contribute to **delivering the Innovation Capabilities of the future railways**

How are the solutions presented?

This catalogue includes 54 solutions in relation to the whole rail system. Each solution includes a description and specifies a targeted market, market outlook and estimated date for market uptake. Also potential benefits and market impact are indicated for all solutions.

Who benefits these solutions are mentioned as follows:

FINAL USER	Travellers and freight transport users
OPERATOR	Rail operator companies
INFRAMAN	Infrastructure management companies
SUPPLIER	Vehicle and part manufacturers

IP1

Passenger trains

Cost-efficient and reliable trains, including high-capacity trains and high-speed trains



Traction Systems	Solution 1. Master Silicon Carbide (SiC) semiconductors Solution 2. High Speed Motor on wheel
TCMS	Solution 3. Next Generation TCMS – New Vehicle Control Unit
COMM	Solution 4. Standardised train-to-ground communication system
Light structures	Solution 5. New Light Carbodies Solution 6. Door leaves Solution 7. Composite door leaves Solution 8. New door functions towards autonomous doors Solution 9. Boarding Aid Solution 10. Lightweight Antenna Supporting Element
Light running gear	Solution 11. ADI spoke wheel
Condition based maintenance	Solution 12. HMS for CBM (bogie and track)
Braking system	Solution 13. EDV devices Solution 14. WSP adaptive control and sander Solution 15. Electro Mechanic Solution 16. Adhesion management solutions
Interiors	Solution 17. Passengers' room adapted to their needs Solution 18. Passengers' room adapted to their needs

Who benefits?

CUSTOMERS

FINAL USER

OPERATOR

INFRAMAN

SUPPLIER

1

Master Silicon Carbide (SiC) semiconductors

- ▶ Applied to rail traction systems (tramway, metro, sub-urban, regional)
- ▶ Complemented by methodologies, tools, standards & norms developed on noise, reliability, smart maintenance, virtual validation and certification

Targeted markets

Tramway, Metro, Sub-Urban, Regional, HST, VHST

S2R Solution available for industrialisation

2021 / 2022

Market outlook

Good perspectives for all trains segments



2 High Speed Motor on wheel

- ▶ Distributed traction on independent wheel bogie to increase traction capabilities
- ▶ Permanent magnet motor with high power and torque density (in terms of weight and volume)
- ▶ Inclusion of permanent magnet motor to increase traction capabilities

Targeted market:

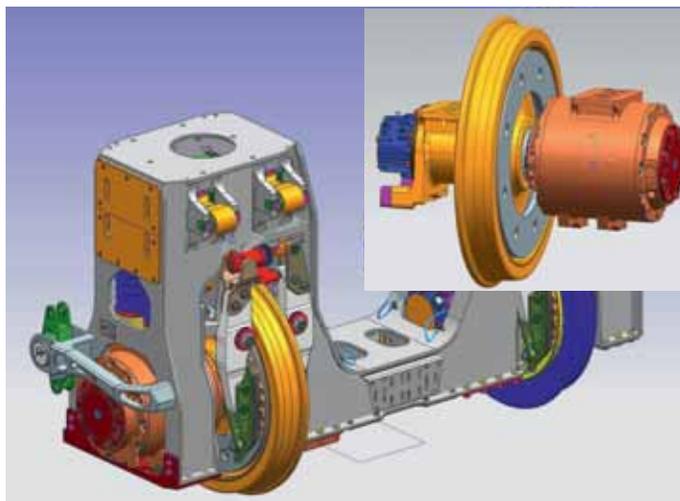
High Speed Trains and Very High Speed Train markets

S2R Solution available for industrialisation:

After 2022

Market outlook:

Applicable for all trains segments



BENEFITS

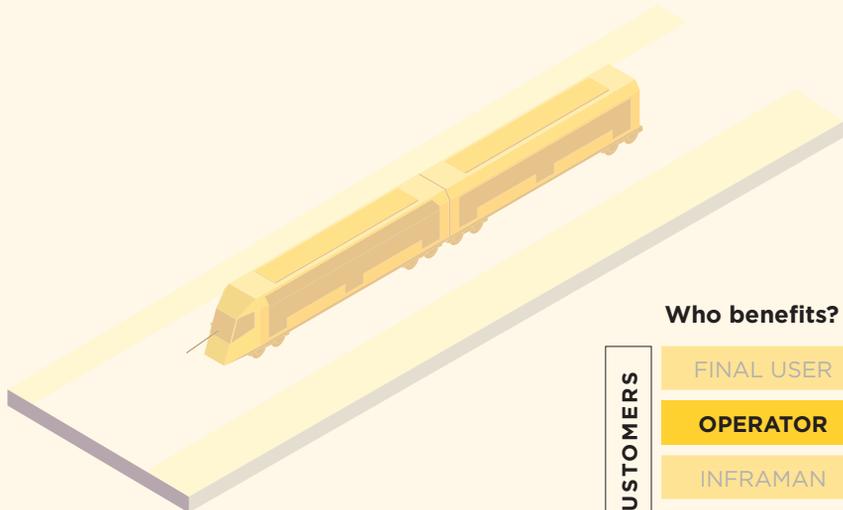
Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

Traction Systems

- Reduced life cycle cost** thanks to lower maintenance (up to -15%) and energy costs (up to -20%) and capital cost reduction via virtual validation & certification
- High reliability, predictive maintenance components** included for higher availability & punctuality of trains
- Lower noise traction components** thanks to specific design optimisation and natural cooling



Who benefits?

CUSTOMERS	FINAL USER
	OPERATOR
	INFRAMAN
	SUPPLIER

3

Next Generation TCMS - New Vehicle Control Unit

TCMS Next GeN

- ▶ New SIL4 functions, while removing safety lines
- ▶ Wireless inter-consist & intra-consist
- ▶ Train-to-ground communications

Functional Distributed Framework defined in the New Vehicle Control Units for TCMS

Targeted market:

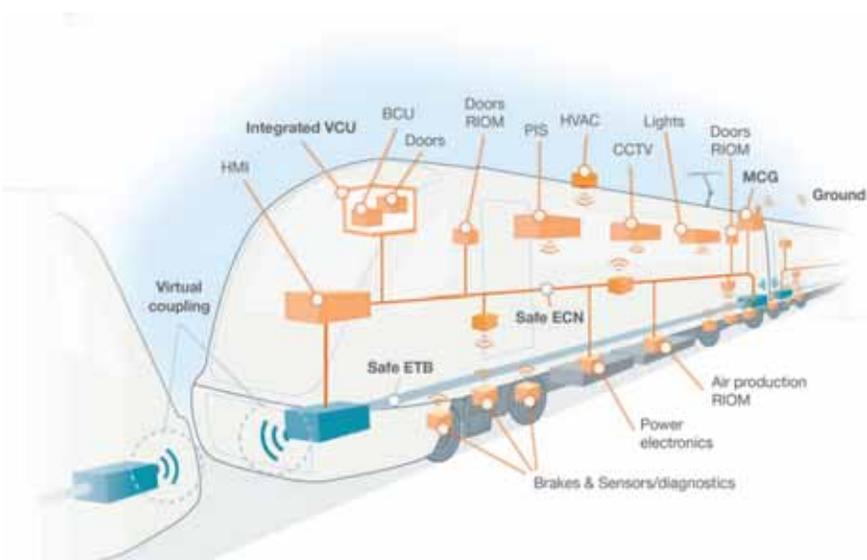
Mainly for the whole rail transport market and possibly even further

S2R Solution available for industrialisation:

Before 2025

Market outlook:

Good perspectives for urban and regional transport



BENEFITS

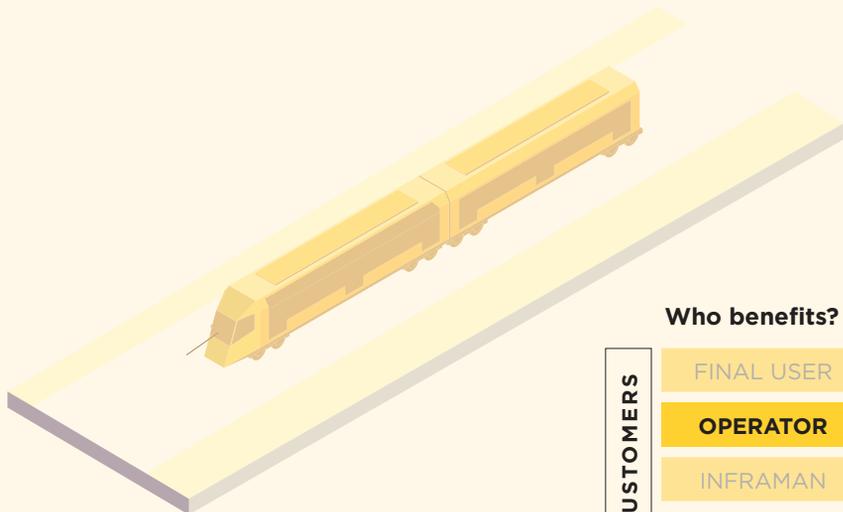
Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

TCMS

- ✓ **50% reduction of trains unavailability** due to better functioning of train control and monitoring
- ✓ **50% cost reduction** in project engineering, integration and certification phases
- ✓ **Safety increase** thanks to enabling the implementation of SIL4 functions in the TCMS
- ✓ **25% weight reduction of cabling** and space used by electronics hardware



Who benefits?

CUSTOMERS	FINAL USER
	OPERATOR
	INFRAMAN
	SUPPLIER

4 Standardised train-to-ground communication system

New standardised train-to-ground communication system for interoperable Mobile Communications Gateways by suppliers

Targeted market:

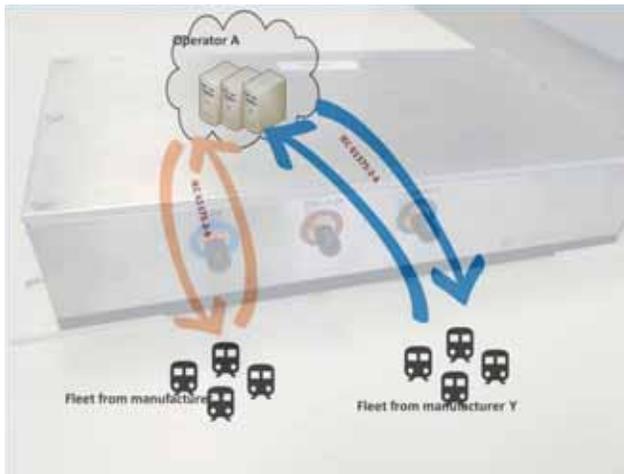
Mainly for rail vehicle market and technology enablers

S2R Solution available for industrialisation:

After 2022

Market outlook:

Good perspectives for urban and regional transport



BENEFITS

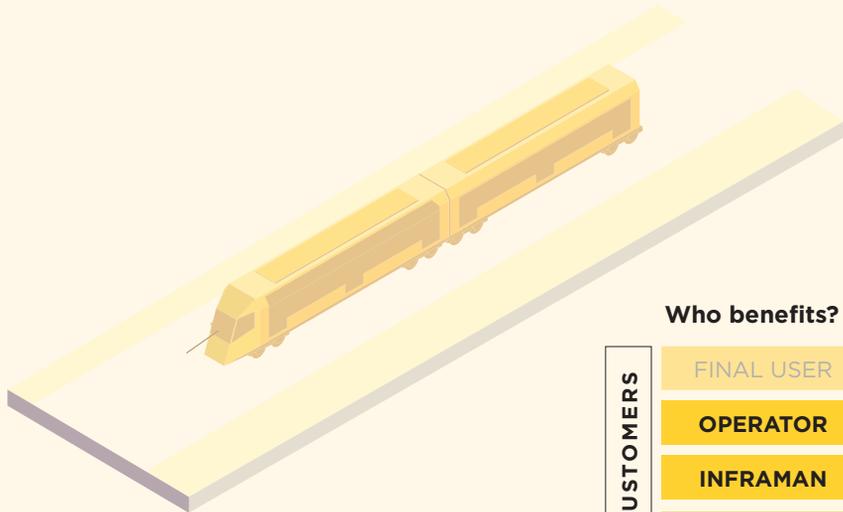
Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

Train communications

- ✓ **50% of trains' availability increase** related to the functioning of train control and monitoring
- ✓ **50% cost reduction** in project engineering, integration and certification phases
- ✓ **Cost reduction and cost-efficient** management of fleets



Who benefits?

CUSTOMERS	FINAL USER
	OPERATOR
	INFRAMAN
	SUPPLIER

5 New Light Carbodies

- ▶ New materials, processes and technologies in the current carbody concepts scalable for manufacturing
- ▶ Hybrid solutions with metallic/composites components due to optimal combination of properties and requirements for high-speed trains.
- ▶ Substitution of welded extruded aluminum profiles by pultruded Carbon Fiber Reinforced Plastics (CFRP) and/or one shot infusion panels of sandwich and CFRP

Targeted market:

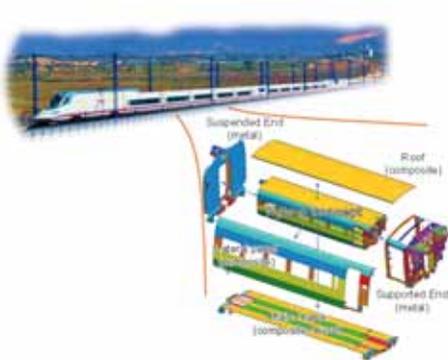
Mainly rail vehicle manufacturer market in metro/regional/high speed transport

S2R Solution available for industrialisation:

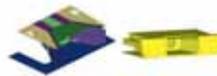
After 2022

Market outlook:

Good perspectives for metro/regional/high speed transport



Coupler end HST Carbody



Headstock Metro Carbody



6 Door leaves

New concept designs of metallic door leaves based on metallic architecture introducing plastic/composite parts, innovative filling materials and sealing solutions

Targeted market:

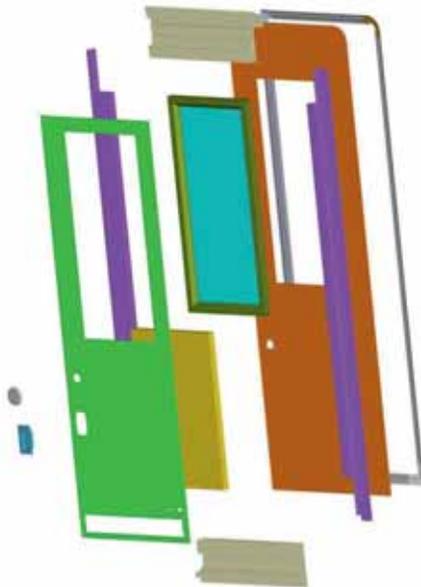
Mainly regional and commuter rolling stock markets worldwide; extended to tramways, metros and up to very high speed trains market.

S2R Solution available for industrialisation:

Progressively partial solution after 2020, integrated solution after 2022

Market outlook:

Good perspectives for all types of trains



7

Composite door leaves

New door leaves designed for thermal insulation, weight reduction and cost by selecting the best composite materials, manufacturing process and architecture

Targeted market:

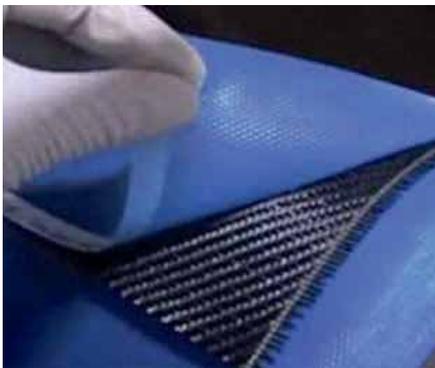
Mainly regional / commuter rolling stock market worldwide and extended to tramways, metros and up to very high speed trains market

S2R Solution available for industrialisation:

Before 2021

Market outlook:

Good perspectives for all types of trains



8 New door functions towards autonomous doors

The solution of adding new door functions will result in easing, helping passenger access and increasing safety while reducing other passenger and neighbourhood disturbances.

Targeted market:

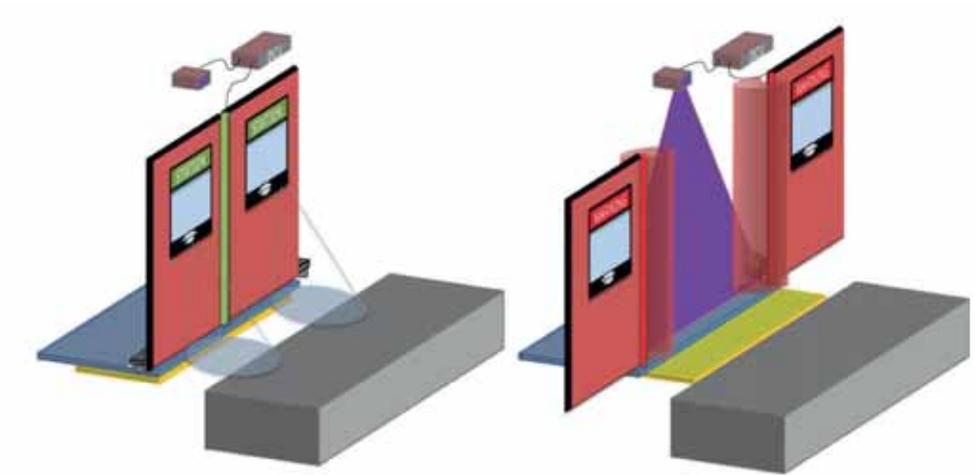
Rolling stock market worldwide

S2R Solution available for industrialisation:

Progressively after 2020 for some individual function. Integrated complete solution after 2022

Market outlook:

Good perspectives for all types of trains except partially metros



9 Boarding Aid

This new accessibility solution will consist of a new bridging plate design to deliver safer and easier passenger boarding and alighting by reducing accessibility barriers.

Targeted market:

Mainly European regional/commuter trains market

S2R Solution available for industrialisation:

Before 2021

Market outlook:

Good perspectives for all types of trains



10 Lightweight Antenna Supporting Element

A new lightweight antenna supporting element will result in weight reduction of the bogie component while making assembly and maintenance work easier.

Targeted market:

Mainly rail components manufacturer market

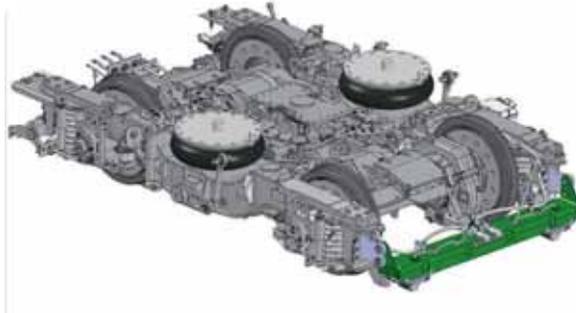
S2R Solution available for industrialisation:

After 2023

Market outlook:

Good perspectives for metro and regional transport

Composite



Conventional



BENEFITS

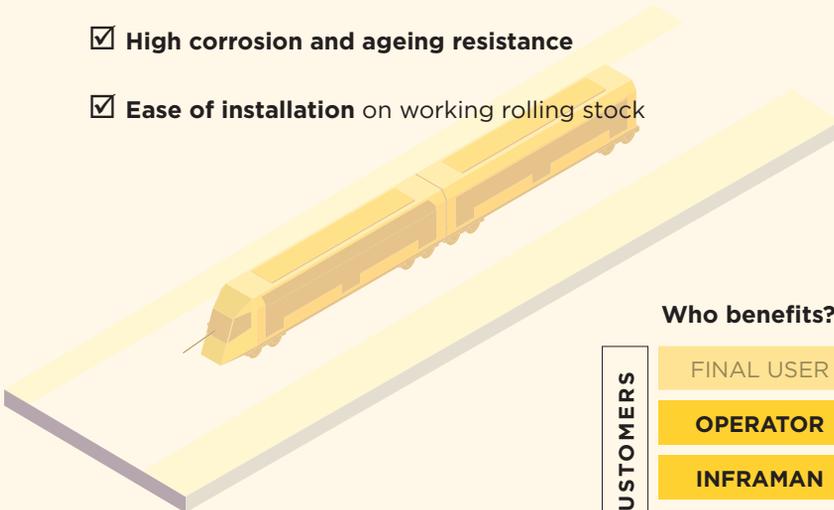
Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

Light structures

- ✓ **Up to 12% energy savings** due to weight reduction
- ✓ **10% capacity increase** for the coaches in new layout configurations
- ✓ **Cost efficiency** due to simplification of manufacturing / assembly
- ✓ **New services and solutions** for rolling stock
- ✓ **Significant increase of thermal insulation and acoustic attenuation**
- ✓ **Low specific weight and higher structural strength**
- ✓ **High corrosion and ageing resistance**
- ✓ **Ease of installation** on working rolling stock



Who benefits?

CUSTOMERS	FINAL USER
	OPERATOR
	INFRAMAN
	SUPPLIER

11 Austempered Ductile Iron (ADI) spoke wheel

New spoke wheel made of Austempered Ductile Iron that will contribute to the potential reduction of maintenance needs of railway vehicles and reduce wheel and infrastructure wear.

Targeted market:

Mainly metro wheelset with monoblock wheels market

S2R Solution available for industrialisation:

After 2021

Market outlook:

Good perspectives for metro and regional transport



BENEFITS

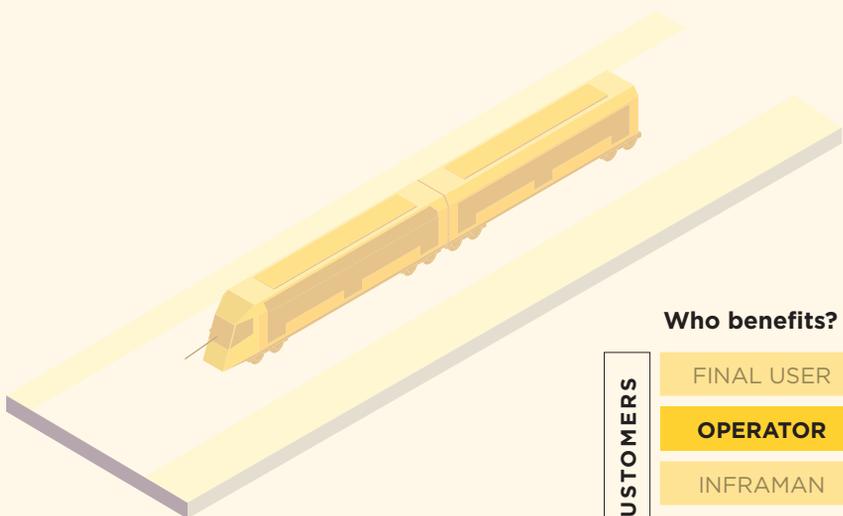
Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

Light running gear

- Reduction of bogie maintenance** by reduction of wheel and polygonisation
- Reduction of infrastructure maintenance cost** by reduction of unsuspended masses
- Possibility for **load increase** by reducing hardware masses
- Reduction of energy consumption** and **noise emission levels**



Who benefits?

CUSTOMERS	FINAL USER
	OPERATOR
	INFRAMAN
	SUPPLIER

12 Health Monitoring Systems for Condition-Based Maintenance (bogie and track)

Development of Health Monitoring Systems to substitute preventive maintenance for Condition Based Maintenance (CBM) focused on both vehicle dynamic and track characteristics making use of hardware and software specifically developed for CBM applications.

Targeted market:

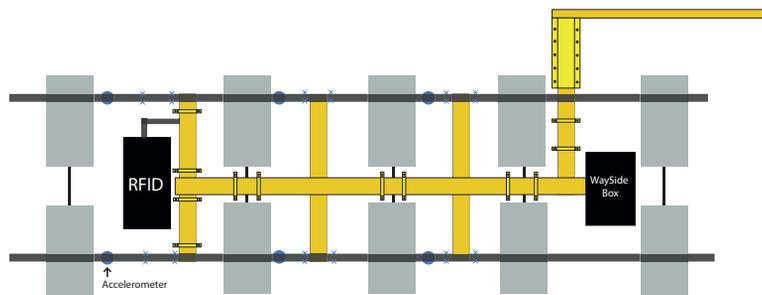
Various markets: mainly metro, also mainline applications

S2R Solution available for industrialisation:

After 2021

Market outlook:

Good perspectives for metro transport and others



BENEFITS

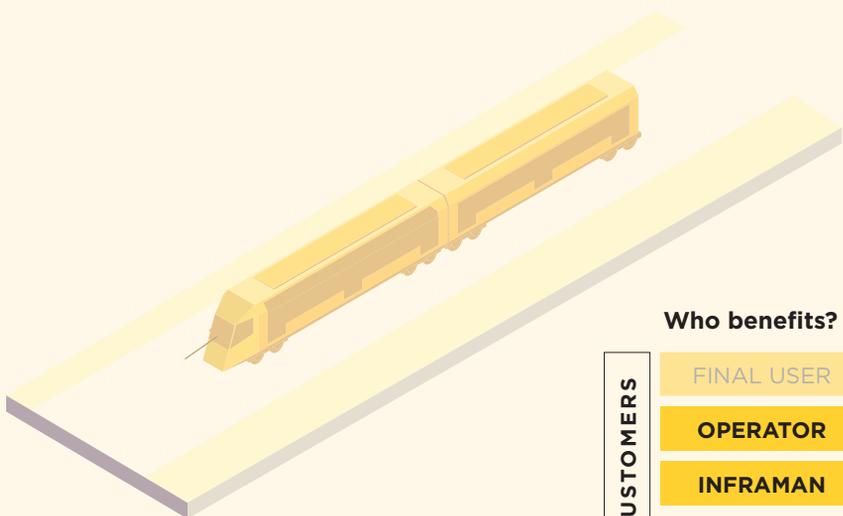
Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

Condition based maintenance

- ✓ **70 % to 90 % reduction of bogie maintenance cost** with preventive maintenance
- ✓ **Optimization** of track maintenance procedures
- ✓ **Reduction of unavailabilities** derived from bogie failure
- ✓ **Safety increase** due to a **continuous monitoring of critical elements** (suspension, track, ...)
- ✓ **Foster** the generation of new services and solutions for vehicle maintenance



Who benefits?

CUSTOMERS	FINAL USER
	OPERATOR
	INFRAMAN
	SUPPLIER

13 Electronic Distributed Valve devices

New Electronic Distributed Valve device (electro-pneumatic and electronic) will enable the capability of being in charge of controlling the Adhesion Dependent Friction Brake at axle level.

Targeted market:

Mainly rail components manufacturer market

S2R Solution available for industrialisation:

Before 2023

Market outlook:

Good perspectives for metro and regional train transport



14 Wheel Slip Protection adaptive control and sander

An innovative solution in brakes to increase safety in low adhesion conditions making use of a Wheel Slip Protection (WSP) adaptive control system together with a new sander solution.

Virtual validation and certification.

Targeted market:

Mainly rail underground (metros) and regional vehicles with future extensions to other types

S2R Solution available for industrialisation:

After 2022

Market outlook:

Good perspectives for metro and regional train transport



15 Electro Mechanic Brake

New generation of Electro Mechanic Brake devices that will enable higher accuracy by significantly reducing weight constraints to the overall braking system and improving the braking performance compared to pneumatic systems.

Virtual validation and certification.

Targeted market:

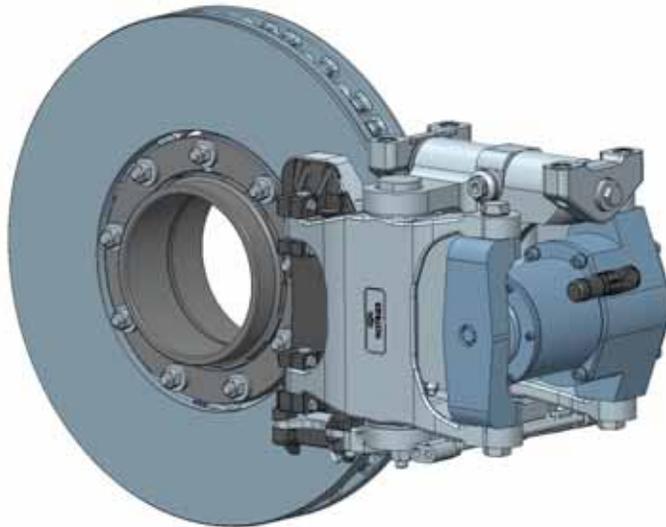
Mainly rail vehicle manufacturer and system suppliers market

S2R Solution available for industrialisation:

Before 2023

Market outlook:

Good perspectives for all types of passenger trains



16 Adhesion management solutions

New adhesion management solutions intended to solve low adhesion issues between wheel and rail and improve rail operation under severe conditions.

Virtual validation and certification.

Targeted market:

Mainly rail vehicle manufacturer and system suppliers market

S2R Solution available for industrialisation:

Before 2021

Market outlook:

Good perspectives for all types of passenger trains



BENEFITS

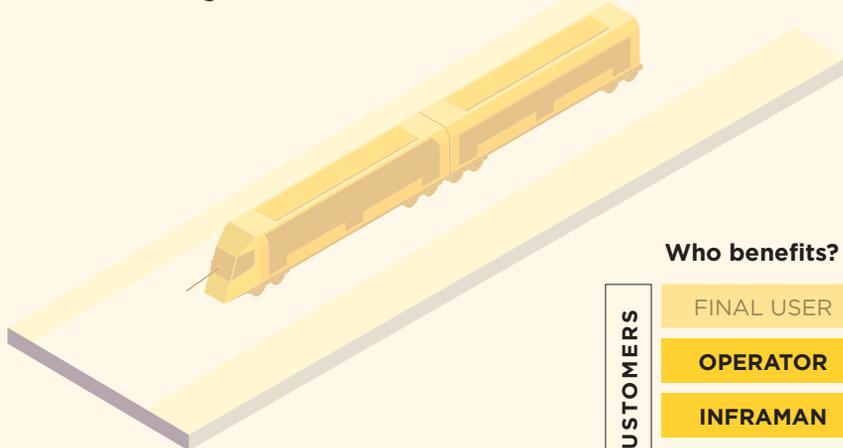
Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

Braking Systems

- ✓ **25% brake performance increase and safety** due to adaptive algorithm for accurate low adhesion situations and increased number of virtual tests
- ✓ **Noise levels significantly reduced**
- ✓ **Life-Cycle Cost Reduction, due to**
 - ▶ reduction of capital cost of the adhesion system
 - ▶ abandoning air supply components
 - ▶ energy savings of up to 15% due to the virtual validation
 - ▶ use of ethernet
 - ▶ reduced number of on-track certification tests
- ✓ **Capacity increase** due to the improvement of the braking distance for future rail traffic



Who benefits?

CUSTOMERS	FINAL USER
	OPERATOR
	INFRAMAN
	SUPPLIER

17 Passengers' room adapted to their needs

This solution intends to increase attractiveness to passengers and flexibility to operators by introducing new evolving interiors design making use of quick fixation concept system for fully plug&play interiors.

Targeted market:

Rolling stock market worldwide including refurbishment

S2R Solution available for industrialisation:

After 2022 for a complete interiors' design

Market outlook:

Good perspectives for urban, regional and high speed trains



18 Driver's Cabin

This solution will enable including new technologies and uses of the driver's cabin to allow the design of Cabin & Driving 2030 which is considering fully autonomous trains in combination with interiors' design and also include the new uses of driver's cabin.

Targeted market:

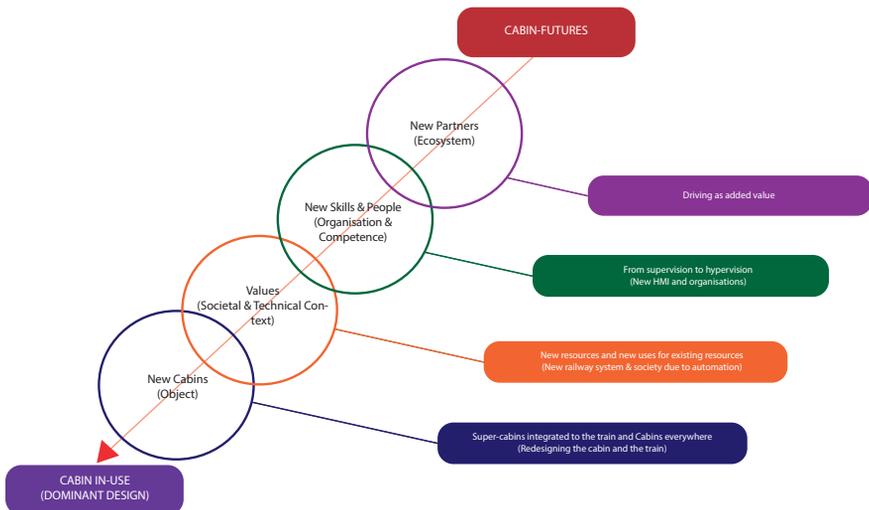
Rolling stock market worldwide and system suppliers

S2R Solution available for industrialisation:

After 2025 for a complete new driver's cabin

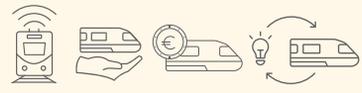
Market outlook:

Few technologies for new cabin available before 2015 with existing standard



BENEFITS

Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

Interiors

- Cost efficiency** and **Life-Cycle Cost decrease** due to
 - ▶ digitalisation of driver's desk, commands and refurbishment capability
 - ▶ new fixation systems for interiors' changing set up
- Safety increased** thanks to new technologies to assist the driver
- Attractiveness** due to new HMI, services and capability to evolve the interiors
- Time to create** a new interior design decreases due to the reduction of assembly time, quick assembly and disassembly
- Increase in the flexibility of operation** due to the new capacity offer to test and deploy new configurations for commercial operation in an easier way



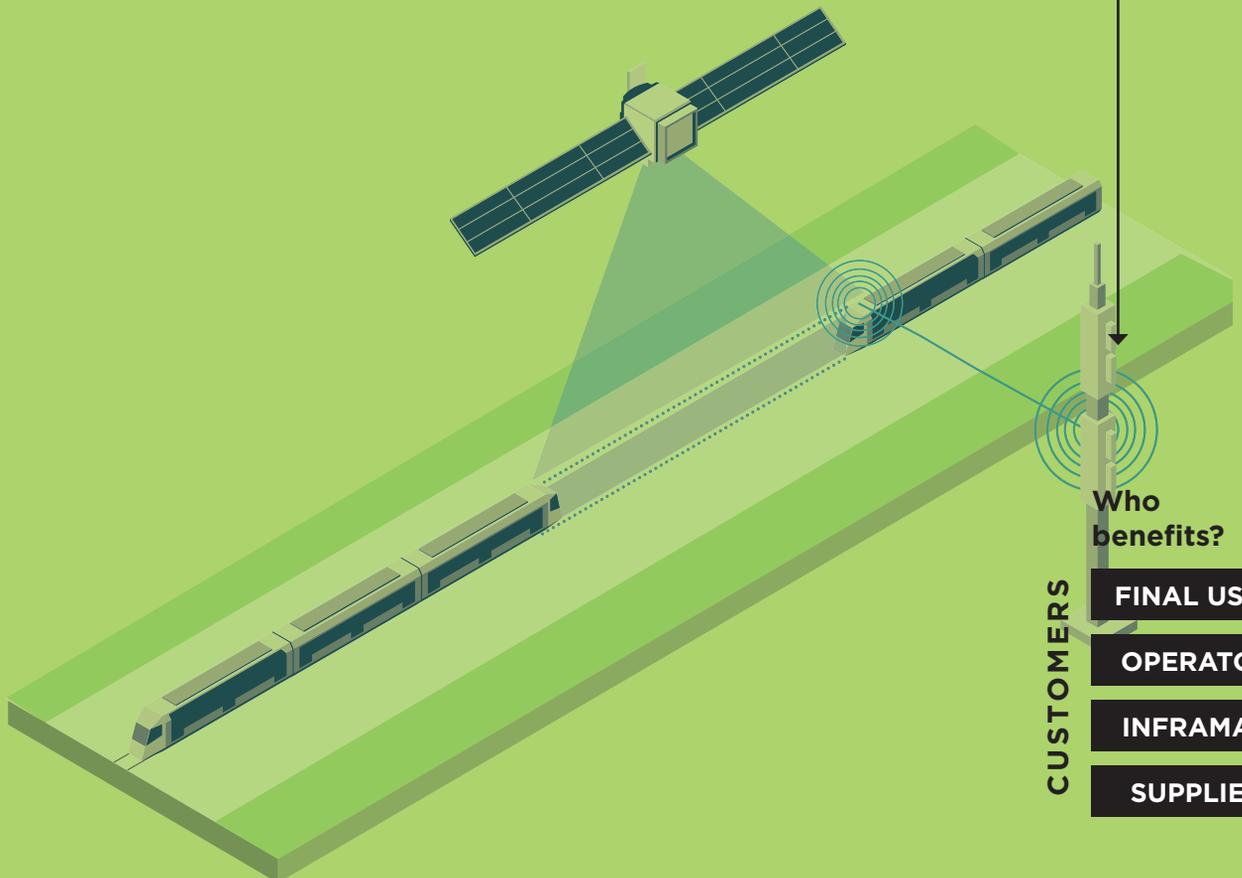
Who benefits?

CUSTOMERS	FINAL USER
	OPERATOR
	INFRAMAN
	SUPPLIER

IP2

Traffic Management Advanced Traffic Management and Control Systems' Solutions

- ERTMS Next Gen**
- Solution 19.** Automatic Train Operation (up to GoA4)
 - Solution 20.** Moving Block
 - Solution 21.** Fail-Safe Train Positioning
 - Solution 22.** Adaptable communication system
 - Solution 23.** Integrated Mobility Management (12M+ TMS)



Who benefits?

CUSTOMERS

FINAL USER

OPERATOR

INFRAMAN

SUPPLIER

19 Automatic Train Operation (up to GoA4)

The standard solution that S2R is developing for mainline applications in different Grades of Automation guarantees the interoperability and interchangeability of the subsystems (trackside and on-board) delivered by different suppliers.

Targeted market:

Mainly technology providers market worldwide

S2R Solution available for industrialisation:

Before 2024

Market outlook:

Good perspectives for all types of trains (mainline/high speed, urban/suburban, regional and freight lines)



20 Moving Block

The Moving block solution aims to increase the line capacity through decoupling the signalling from physical infrastructure and decreasing the constraints imposed by trackside train detection resulting in the increase of transit of trains.

Targeted market:

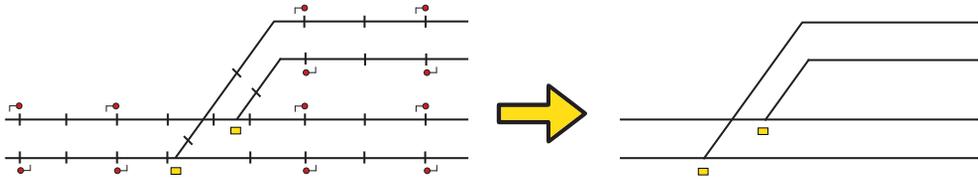
Mainly technology providers market worldwide

S2R Solution available for industrialisation:

Before 2024

Market outlook:

Good perspectives for all types of trains (mainline/high speed, urban/suburban, regional and freight lines)



21 Fail-Safe Train Positioning

The Fail-Safe Train Positioning (including satellite technology) is aimed to become an absolute positioning system, by applying GNSS technology to the ERTMS/ETCS core and by using new technologies (e.g. inertial measurement units) or other on-board existing sensors (e.g. accelerometers, odometer sensors).

The Fail-Safe Train Positioning aims to boost the quality of train localization and integrity information, while also reducing overall costs, in particular by enabling a significant reduction in track-side conventional train detection systems (e.g. track circuits, axle counters) and physical balises.

Targeted market:

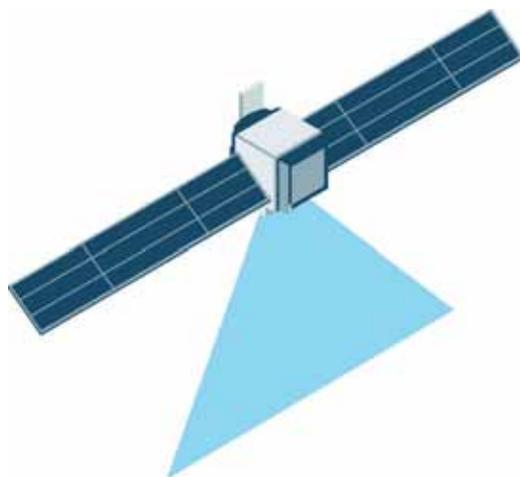
Mainly technology providers market worldwide

S2R Solution available for industrialisation:

Before 2024

Market outlook:

Good perspectives for all types of trains (mainline/high speed, urban/suburban, regional and freight lines)



22 Adaptable communication system

This adaptable communication system will be able to decouple the applications from the underlying radio access networks and provide generic communication services based on bearer flexibility with defined Quality of Service (QoS) leveraging multiple access technologies (LTE, 5G, SatCom, WiFi, ...)

Targeted market:

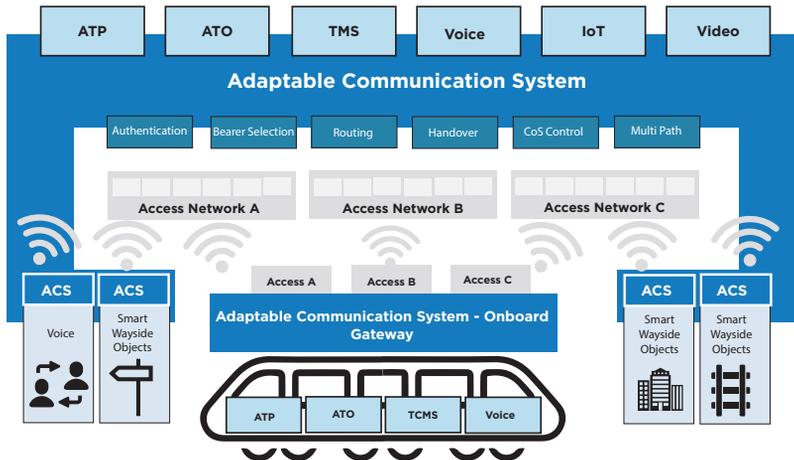
Mainly rolling stock and technology providers market

S2R Solution available for industrialisation:

Before 2024

Market outlook:

Good perspectives for all types of trains (mainline, urban and freight)



23 Integrated Mobility Management (I2M+ TMS)

The Integrated Mobility Management solution combined with the solution arising from Traffic Management work stream aims at integrating the data exchange between all rail business services into one communication platform, the Integration Layer.

Targeted market:

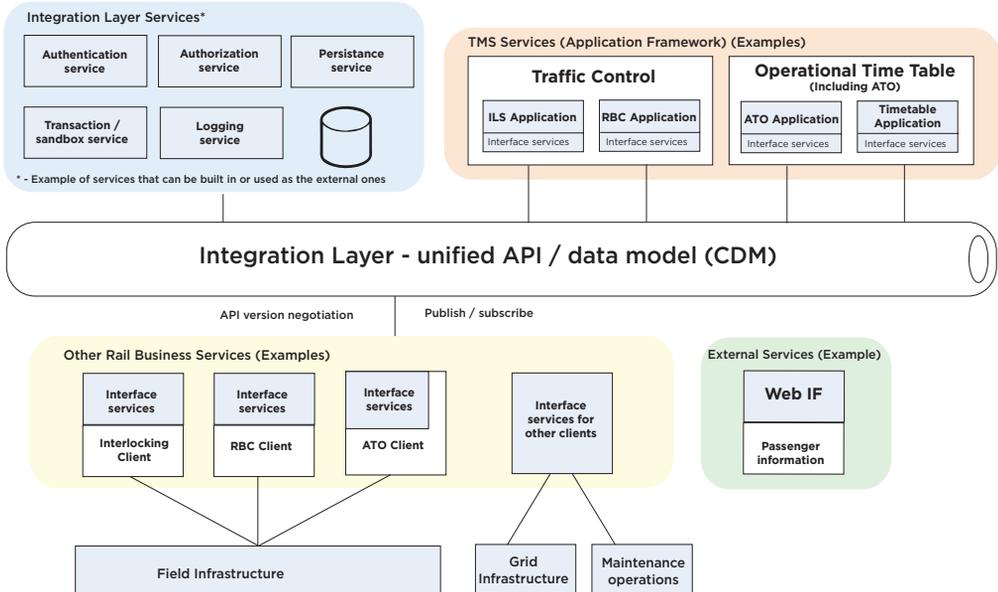
Mainly railway operating companies and technology suppliers market

S2R Solution available for industrialisation:

Before 2022

Market outlook:

Good perspectives for all market segment



BENEFITS

Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

ERTMS Next Generation

- ✓ 50% better **punctuality and less variability** due to ATO in all GoA,
- ✓ **Increased operations and capacity** on existing tracks
- ✓ **Energy savings** of up to 45% through optimised speed profiles
- ✓ **Enhanced Productivity** due to driverless and unattended operations
- ✓ **New and dynamic control of train management**
- ✓ **Decoupling applications** from the radio access networks in order to lower integration costs and avoid making independent upgrades
- ✓ **Improved coverage** as well as enabled **cost efficient access alternatives**
- ✓ **New services and solutions for signalling systems**
- ✓ **Increase of operational reliability**
- ✓ **Better forecasting of traffic** and **reduce delays**
- ✓ **Increase of the efficiency of Passenger and Rail Freight Operations**
- ✓ **New services and solutions for mobility management and smart planning**

Who benefits?

CUSTOMERS

FINAL USER

OPERATOR

INFRAMAN

SUPPLIER

IP3

Optimised Infrastructure

Intelligent Asset Management & High Capacity Infrastructure

Long performing structures

Solution 24. Low cost high speed bridges

Solution 25. Long performing structures

Track system

Solution 26. Enhanced switches and crossings system

Solution 27. High performance wheel-rail interaction

Maintenance

Solution 28. Data for Track Circuit Maintenance

Solution 29. Data & Positioning: Lean Tamping

Solution 30. Automation: Robot platform

Solution 31. High-pressure waterjet cutting

Solution 32. DATA: Integrated Measuring System

Solution 33. DATA: Decision making plan

Energy

Solution 34. Smart Energy Metering



24 Low cost high speed bridges

Low-cost high-speed bridges solution will improve the understanding of bridge-train dynamic interactions and how damping will allow to reduce unnecessary expensive special solutions for bridges.

Targeted market:

Mainly technology providers market worldwide

S2R Solution available for industrialisation:

2023

Market outlook:

Good perspectives for infrastructure managers that own bridges



25 Long performing structures

This long-performing structures solution aims at increasing the longevity of infrastructure projects before becoming critical and has effective improvement solutions so that structures can be restored without disturbing traffic through regulating speed and structure availability.

Targeted market:

Mainly technology providers market worldwide

S2R Solution available for industrialisation:

2023

Market outlook:

Good perspectives for infrastructure managers that own bridges



BENEFITS

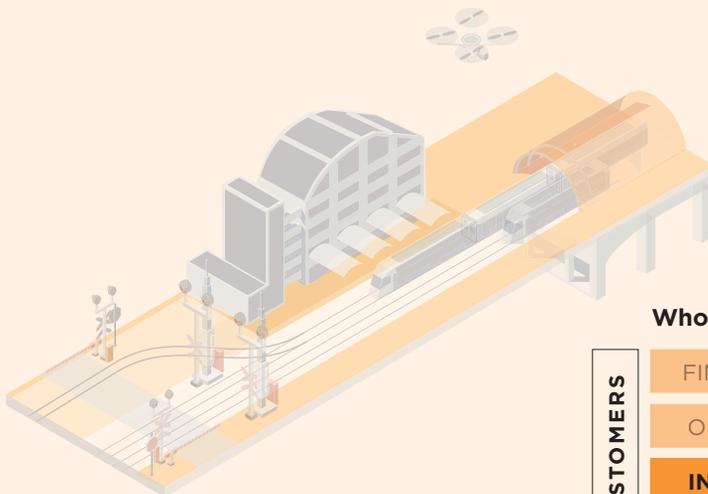
Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

Long performing structures

- ✓ **Capacity increase** and **reduced structure unavailability** leading to higher punctuality
- ✓ **New bridges** to be built making use of this solution may end up **lowering the cost** up to 25% + **Cost efficient solution** as replacement of structure is delayed
- ✓ **Safety increase** due to uniform treatment of safety
- ✓ **Energy savings of up to 25%** from bridges energy consumption due to less material usage and **of at least 10 %** due to prolonged usage of already existing structures



Who benefits?

CUSTOMERS

FINAL USER

OPERATOR

INFRAMAN

SUPPLIER

26 Enhanced switches and crossings system

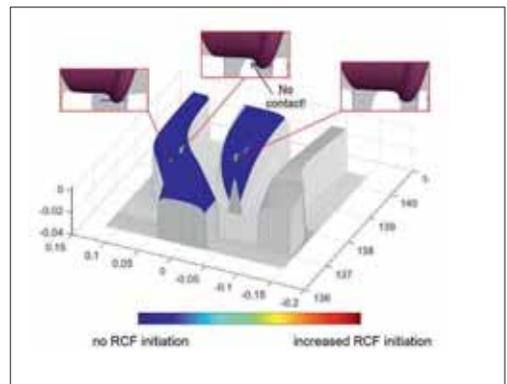
This solution will result in developing an enhanced switches and crossings (S&C) system that will improve the operational performance of existing designs through the delivery of new sub-systems with sensing and monitoring capabilities and self-adjustment.

Virtual simulation of dynamic behaviour of a S&C and the deterioration of its components resulting from vehicle interaction. It will support the development towards virtual authorisation.

Targeted market:
Mainly system suppliers market

S2R Solution available for industrialisation:
2023

Market outlook:
Good perspectives for infrastructure managers



BENEFITS

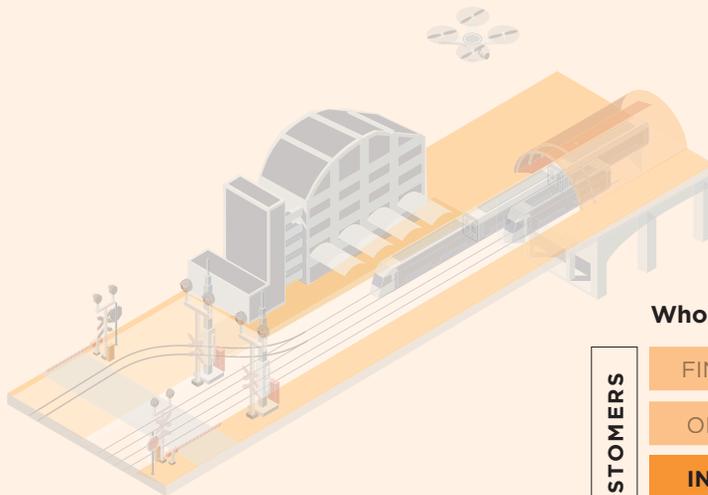
Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

Enhanced switches and crossings system

- ✓ **Maintenance reduction** based on condition-based maintenance of railway assets and **continuous improvement of components and maintenance schedules**.
- ✓ **Enhancement of capacity and punctuality increase** as less interruptions will occur.
- ✓ **Improved possibilities for remote monitoring** of the system.
- ✓ **Increase asset status monitoring capabilities**



Who benefits?

CUSTOMERS

FINAL USER

OPERATOR

INFRAMAN

SUPPLIER

High performance wheel-rail interaction

This solution aims at providing a mechanical/structural improvement of existing rail and wheels interaction performance.

System simulations aim at providing an innovative way for testing new solutions for track and wheels.

Targeted market:

Mainly wheel set manufacturer and system suppliers market

S2R Solution available for industrialisation:

2025

Market outlook:

good perspectives for freight and passengers train suppliers, Wheelset manufacturers, and infrastructure managers.



BENEFITS

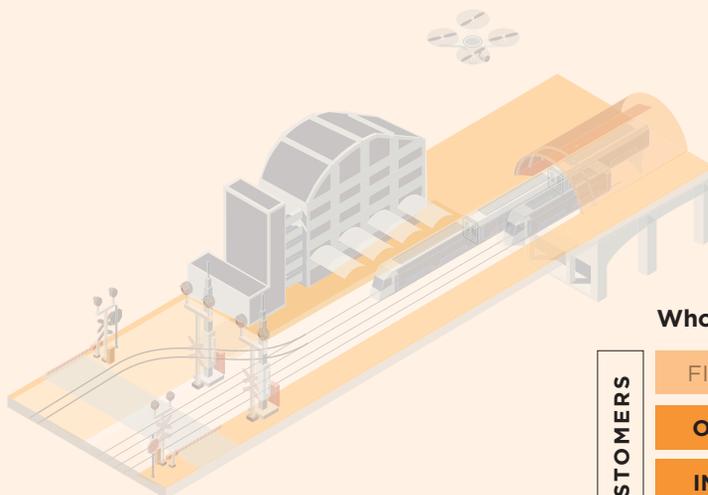
Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

High performance wheel-rail interaction

- Enhancement of capacity** for infrastructure and operations.
- Life cycle-costs decrease** of the wheel/rail system.
- Punctuality increase** by less capacity consumptions.
- Reduced levels of noise and vibration.**
- Improvement on the loading capacity** for rolling stock.
- Better comfort level for passengers.**



Who benefits?

CUSTOMERS

FINAL USER

OPERATOR

INFRAMAN

SUPPLIER

28 Data for Track Circuit Maintenance

Innovative S2R solution for Track Circuits maintenance. This market solution consists of a big data platform, which provides the current status, anomaly detection and predictive analysis of the Track Circuits assets. It will lead to better support for maintenance action plans.

Targeted market:

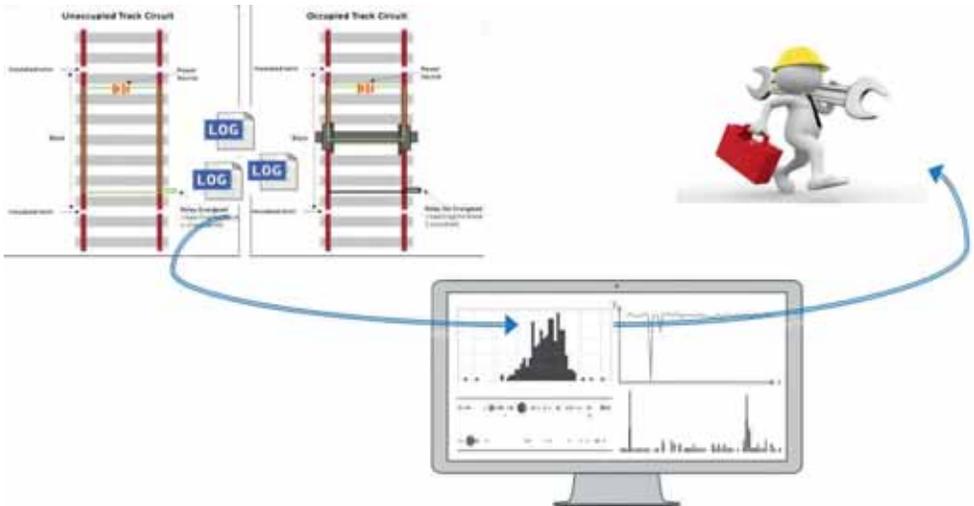
All markets (mainline, urban, regional) infrastructure

S2R Solution available for industrialisation:

2023

Market outlook:

Infrastructure managers, and entities in charge of maintenance.



29 Data & Positioning: Lean Tamping

The lean tamping process eliminates the step of pre-measurements between the track measurement and the tamping.

Targeted market:

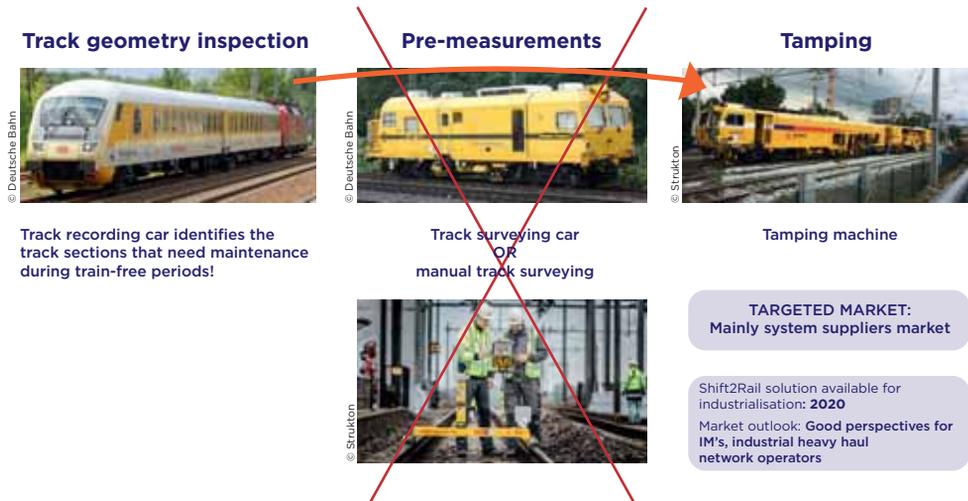
Mainly system suppliers market

S2R Solution available for industrialisation:

2020

Market outlook:

Good perspectives for infrastructure managers, industrial heavy haul network operators



30 Automation: Robot platform

This solution in combination of the ones presented for lean tamping and decision-making planning. It will result in automatised operations for maintenance tasks and will significantly reduce manual and arduous work on-site.

Targeted market:

Mainly system and technology suppliers market

S2R Solution available for industrialisation:

2023/2024

Market outlook:

Good perspectives for system and technology suppliers, infrastructure managers, and entities in charge of maintenance.



31 High-pressure waterjet cutting

This solution using high-pressure waterjet cutting machine is a sustainable technology for a new rail maintenance process.

Targeted market:

Mainly system and technology suppliers market

S2R Solution available for industrialisation:

Before 2023

Market outlook:

Good perspectives for infrastructure in mainline, urban, regional)



32 Integrated measuring system

The integrated measuring system will contribute to decreased service disruptions and lower maintenance costs through continuous non-intrusive monitoring of rail thermal stress by incorporating this system on in-service trains. Data can be used to minimize risks/failures induced by thermal stress.

Targeted market:

Mainly system and technology suppliers market

S2R Solution available for industrialisation:

2026

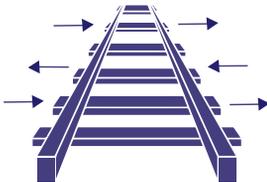
Market outlook:

Good perspectives for IMs

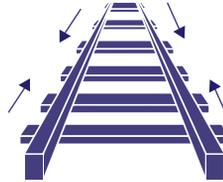
Rail thermal stress causes



At high temperatures
RAIL BUCKLING



At low temperatures
RAIL BUCKLING



33 Decision making planning

This solution will improve the utilisation of resources and maintenance through the development of a generic framework for the decision-making process when planning maintenance and interventions, which will lead to reduction of time consumption and repetitive work.

Targeted market:

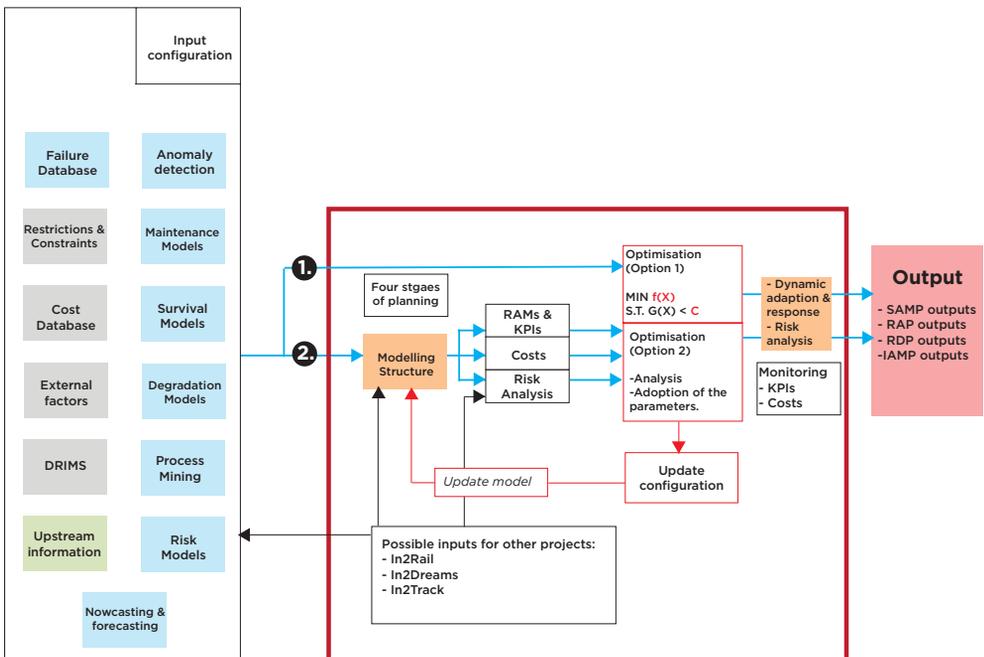
Mainly technology suppliers market

S2R Solution available for industrialisation:

2023

Market outlook:

Railway undertakings, infrastructure managers and service providers



BENEFITS

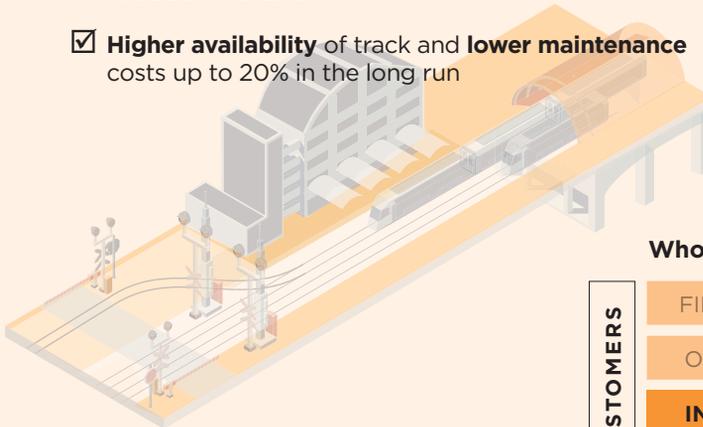
Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

Maintenance

- ✓ Foster the generation of new services and solutions for an **Intelligent Asset Management System**
- ✓ Reduction of **manual and arduous work** to a minimum
- ✓ Accuracy of data and **better traceability** of works carried out
- ✓ **Eases asset management** tasks and planning
- ✓ Increases **safety** and reduces **cost** (up to 35%) by also improving **quality**
- ✓ Minimum service disruptions (reduction by 50 to 70%)
- ✓ Life cycle costs **reduction based on condition based** maintenance of railway assets and continuous improvement of components/maintenance schedules.
- ✓ **Increase of punctuality** based on targeted maintenance interventions and fewer interventions due to sudden failures
- ✓ **Higher availability** of track and **lower maintenance** costs up to 20% in the long run



Who benefits?

CUSTOMERS

FINAL USER

OPERATOR

INFRAMAN

SUPPLIER

34 Smart energy metering

This innovative solution for railway system energy efficiency measurements both on-board trains and on the electrical infrastructure will support in decision-making process and lead to cost-efficient actions.

Targeted market:

Mainly system and technology suppliers market

S2R Solution available for industrialisation:

2022

Market outlook:

Infrastructure managers, railway undertakings, transport authorities



BENEFITS

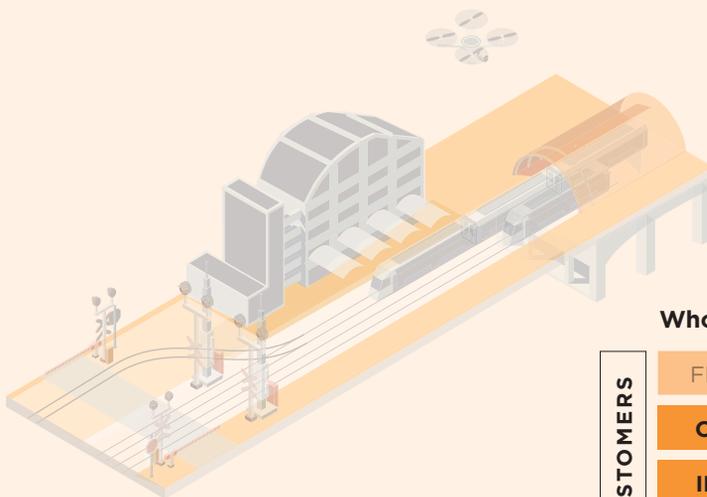
Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

Energy

- ✓ Considerable **improvement** of the railway system's **energy efficiency**
- ✓ **Help** decision making process on **operational issues**
- ✓ **Eases asset management tasks**
- ✓ Contribution to **better plan investments** and evaluation of the railway system's **energy efficiency**
- ✓ Helps taking **operational decisions based on real data**
- ✓ **Improves** railway system's **life cycle costs**
- ✓ **Shares information** with travelers and promotes good practices for **energy efficiency**



Who benefits?

CUSTOMERS	FINAL USER
	OPERATOR
	INFRAMAN
	SUPPLIER

IP4

Digital services

Towards “mobility as a service” engineered by railway

Multimodal eco-system

Solution 35. Seamless Multimodal Travel

Travel experience

Solution 36. Travel Companion-Personal Application

Travel provider tools

Solution 37. Contractual Management Market Place

Solution 38. Business Analytics for Transportation

Solution 39. Interoperability Framework



Who benefits?

CUSTOMERS

FINAL USER

OPERATOR

INFRAMAN

SUPPLIER

35 Seamless multimodal travel

The seamless multimodal travel experience solution will create an eco-system which allows one-stop-shops for pan-European door-to-door itineraries including multimodal travel planning, booking, ticketing and payment, trip tracking and additional services.

Targeted market:

Mainly system and technology suppliers market

S2R Solution available for industrialisation:

End of 2022

Market outlook:

Good perspectives for travel service operators, infrastructure managers and railway undertakings



BENEFITS

Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

Multimodal eco-system

- ✓ Allows the user to search for the **best itineraries** and **offers** fulfilling their mobility needs
- ✓ Provides **best routes to travellers** taking into account their special needs and preferences
- ✓ Includes booking, payment, issue and validation functionalities and **additional services** such as aftersales and passenger rights
- ✓ Allows **different validation** and **defines guidelines** for setting business-to-business contracts and agreements
- ✓ Keeps the **traveller informed** through the whole journey
- ✓ Provides **alternative routes** whenever a disruption may happen
- ✓ Takes **additional information** like prognosis data into consideration



Who benefits?

CUSTOMERS	FINAL USER
	OPERATOR
	INFRAMAN
	SUPPLIER

36 Travel companion personal application

The travel companion personal application will provide the travelers with an access to European door-to-door multimodal transport services through a unique user interface. It will enable the user to access information related to travel services and real time information.

Targeted market:

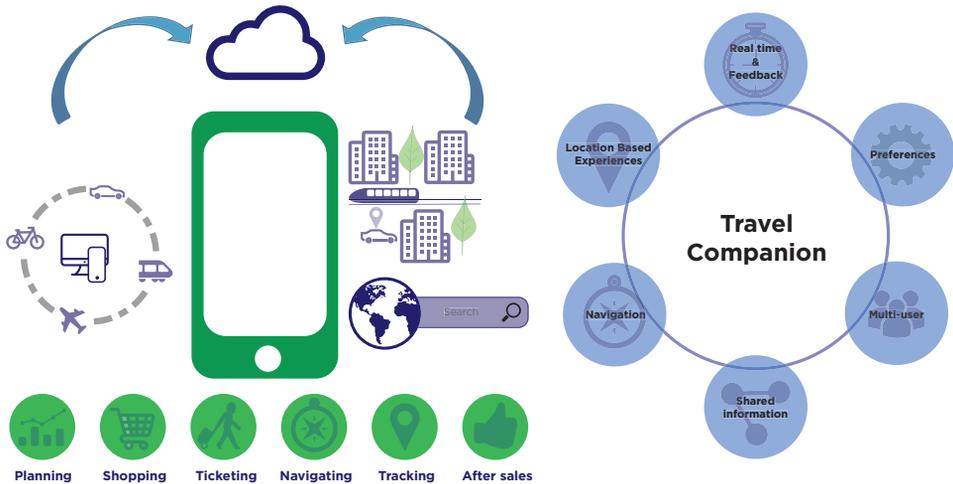
Mainly system and technology suppliers market
Travel service providers

S2R Solution available for industrialisation:

End 2022

Market outlook:

Good perspectives for travel service operators of every mode of transport and mobility services



BENEFITS

Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

Travel companion personal application

- Provides a **secured cloud-based platform** to store user account data, passenger travel rights and travel wallets amongst other type of information
- Provides **guidance** and **interchange navigation functions** for indoor/outdoor travel episodes
- Provides new forms of **location-based Experiences**
- Takes into account **services** such as **multi-user** and **group travel aspects**
- Collects feedback data to **improve real time information** through the Trip Tracker
- Integration by **other applications** is foreseen and possible



Who benefits?

CUSTOMERS

FINAL USER

OPERATOR

INFRAMAN

SUPPLIER

BENEFITS

Contributes to the following future rail capabilities (see page 11 for reference)



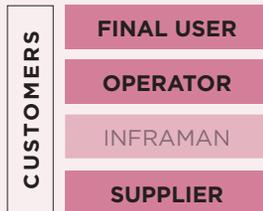
Potential benefits and market impact

Contractual Management Market Place

- ✓ Allow registered users to **create and configure multimodal agreements and business rules**
- ✓ Users can **manage the agreements** (accept/reject/modify) **and contracts**
- ✓ Possibility for users to see **financial transactions** (tickets sold, compensation, etc.)
- ✓ Future evolutions will create **intermodal agreements and MaaS mobility packages** and evolve to offer other capabilities to TSPs.



Who benefits?



38 Business Analytics for Transportation

The business analytics for transportation solution will provide a common foundation for all S2R transport product and service providers based on data coming from TSPs in order to better adapt the level of service to the users demand.

Targeted market:

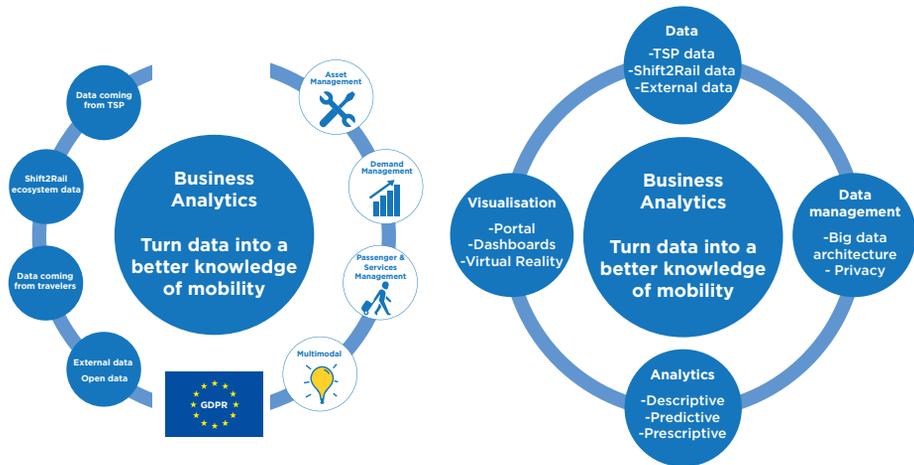
Mainly system and technology suppliers market
Travel service providers

S2R Solution available for industrialisation:

End 2022

Market outlook:

Good perspectives for travel service providers of every mode of transport and mobility services, also for traffic managers



BENEFITS

Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

Business Analytics for Transportation

- ✓ The business analytics framework is based on **rich data collection**
- ✓ Data integration inside a **powerful big data architecture**
- ✓ Development of **anonymization techniques** to address GDPR
- ✓ Rich algorithms perform **descriptive, predictive** and **prescriptive analytics**
- ✓ Interactive and **dynamic visualization capabilities** such as Virtual Reality



Who benefits?

CUSTOMERS	FINAL USER
	OPERATOR
	INFRAMAN
	SUPPLIER

39 Interoperability Framework

The Interoperability Framework (IF) solutions will foster the digital transformation of the transport ecosystem and facilitate interoperability among heterogeneous systems to make possible the provision of multimodal services that combine information and services from different TSPs.

Targeted market:

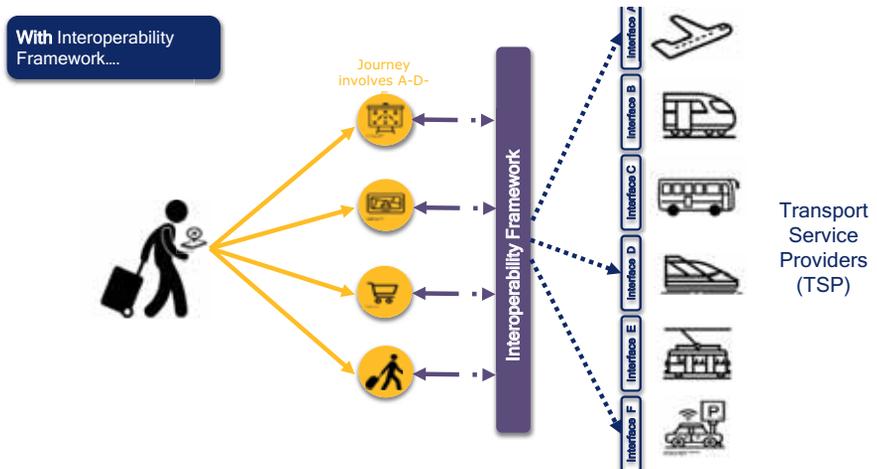
Mainly system and technology suppliers market
Travel service providers

S2R Solution available for industrialisation:

End of 2022

Market outlook:

Good perspectives for travel service providers of every mode of transport and mobility services providers



BENEFITS

Contributes to the following future rail capabilities (see page 11 for reference)



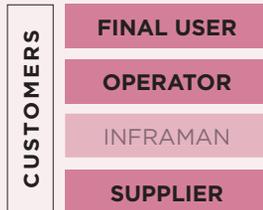
Potential benefits and market impact

Interoperability Framework

- ✓ Allows **heterogeneous systems interoperating** without changes in their interfaces
- ✓ Manages **assets and ontologies**
- ✓ **Reduces implementation costs** on the side of multimodal business apps and on the side of TSPs
- ✓ Permits **not only addressing rail** but also other modes. Independent of a rail-specific standard or other standards



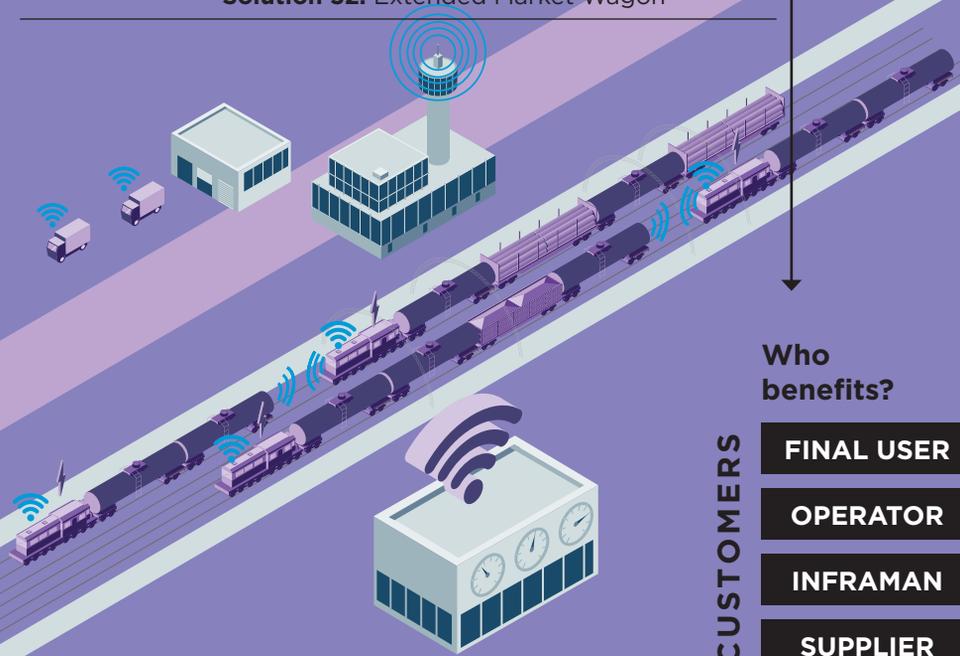
Who benefits?



IP5

European Railway Freight Technologies for sustainable and attractive European Rail Freight

ATO	Solution 40. ATO GoA 2 for existing fleet Solution 41. Obstacle Detection System (ODS) Solution 42. Freight Automatic Coupler
Maintenance	Solution 43. Condition based and predictive maintenance
Traction power	Solution 44. Distributed Power for long trains Solution 45. Full Electric Last Mile Propulsion Solution 46. Battery module
Operations	Solution 47. Yard and Network management Solution 48. Digital brake test Solution 49. Intelligent video gate
Wagon	Solution 50. Light Thermostable Wheel Solution 51. Silent Wheelset Solution 52. Extended Market Wagon



Who benefits?

CUSTOMERS

FINAL USER

OPERATOR

INFRAMAN

SUPPLIER

40 ATO GoA 2 for existing fleet

The solution that is currently being tested will result in a significant contribution to the standardization committees and ERA TSI CCS, particularly concerning interchangeability of GoA2 modules, as basis for future solutions to be implemented. The solution will also give insights into functionality with freight set-up on track.

Targeted market:

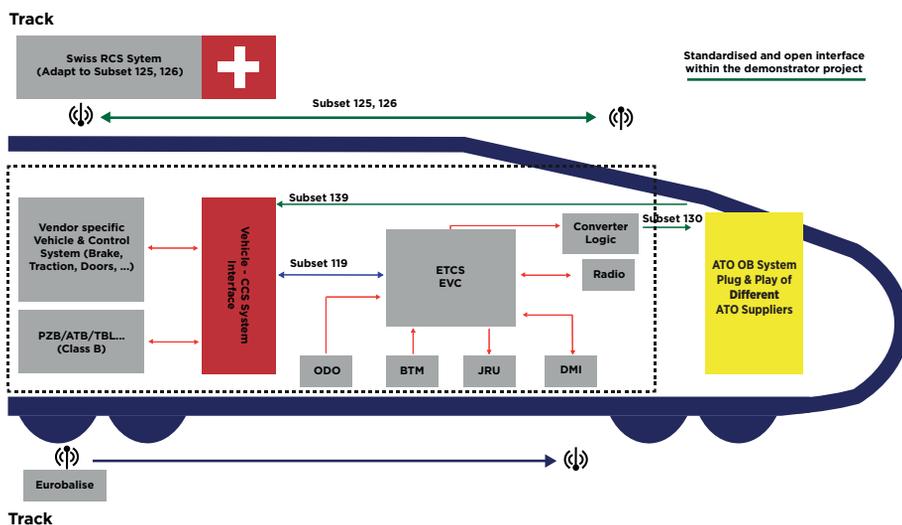
Mainly railway undertakings focussed on the growth of pan-European mainline operations market

S2R Solution available for industrialisation:

End of 2020

Market outlook:

Good perspectives for infrastructure managers and European railway undertakings



41 Obstacle Detection System (ODS)

With this solution S2R develops a system capable of recognising threats in vehicles surrounding environment by using different sensing technologies. Applying this solution will drastically reduce the risk of collisions and increase safety in operations.

Targeted market:

Mainly freight trains market, surround sensing for all mainline applications and technology providers market worldwide

S2R Solution available for industrialisation:

2022

Market outlook:

Good perspectives for freight operators, infrastructure managers and railway undertakings.



42 Freight Automatic Coupler

This new Freight Automatic Coupler solution will be a key component that will contribute to the automation of shunting operations and will include additional functionalities to the system by introducing electricity into the wagons.

Targeted market:

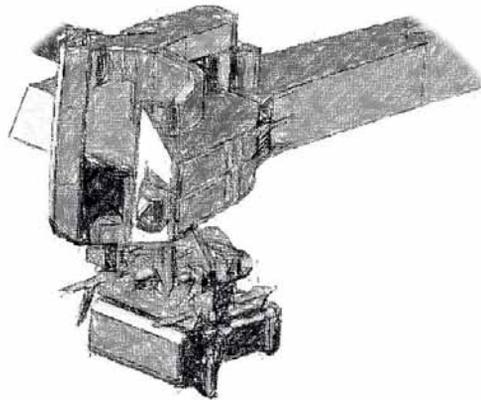
Mainly all European freight wagons market

S2R Solution available for industrialisation:

2021

Market outlook:

Good perspectives for rolling stock owners and operators, wagonload operators



BENEFITS

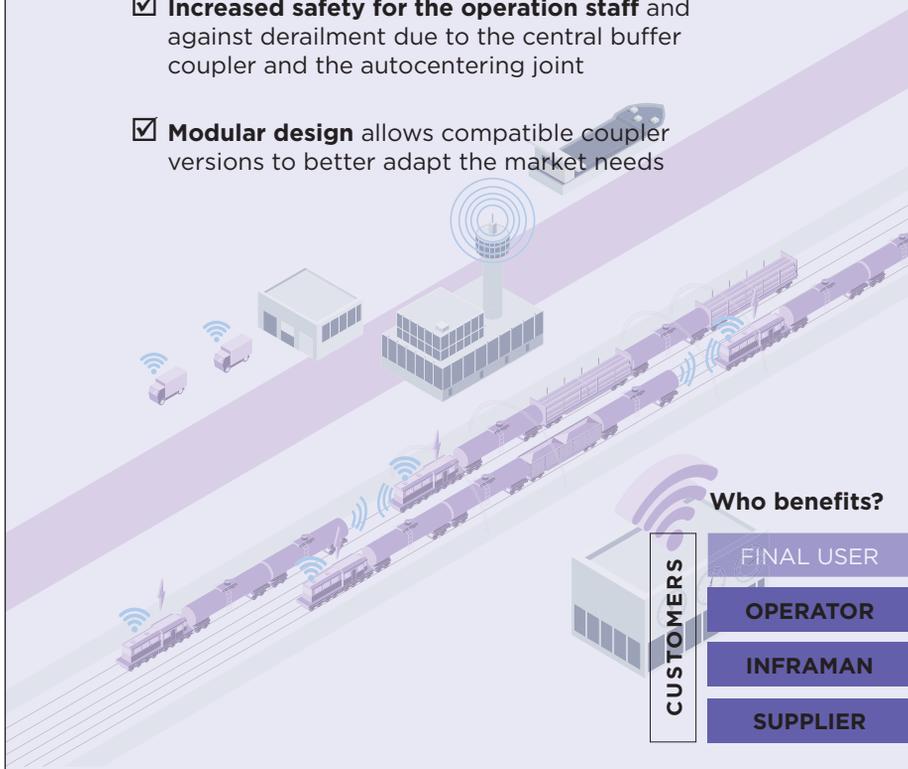
Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

ATO

- Reduction of operational costs**
- Energy savings of up to 10%**
- Capacity increase**
- New services and solutions for automated corridor operation**
- Increased safety for the operation staff** and against derailment due to the central buffer coupler and the autocentering joint
- Modular design** allows compatible coupler versions to better adapt the market needs



Who benefits?

- CUSTOMERS**
- FINAL USER
- OPERATOR
- INFRAMAN
- SUPPLIER

43 Condition based and predictive maintenance

The solution will result in the development of an overall condition based and predictive maintenance strategy for freight rolling stock that will lead to a further reduction of cost and increase of fleet usage efficiency.

Targeted market:

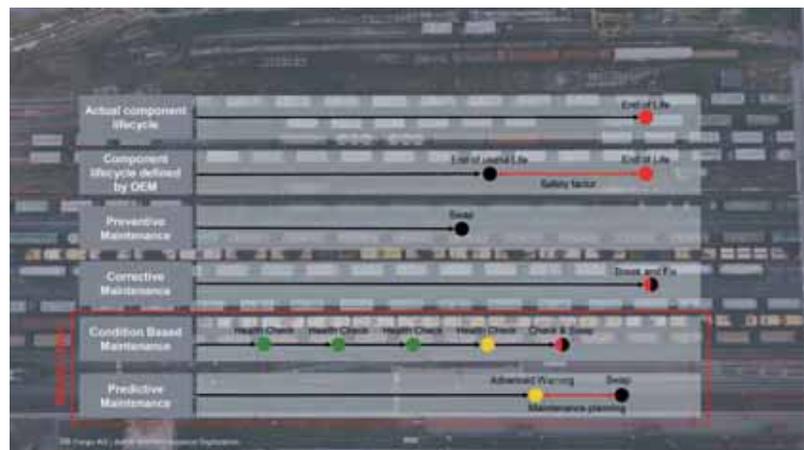
Mainly railway undertakings focussed on growth of pan-European mainline operations market

S2R Solution available for industrialisation:

2019 for first release

Market outlook:

Good perspectives for railway undertakings and entities in charge of maintenance)



BENEFITS

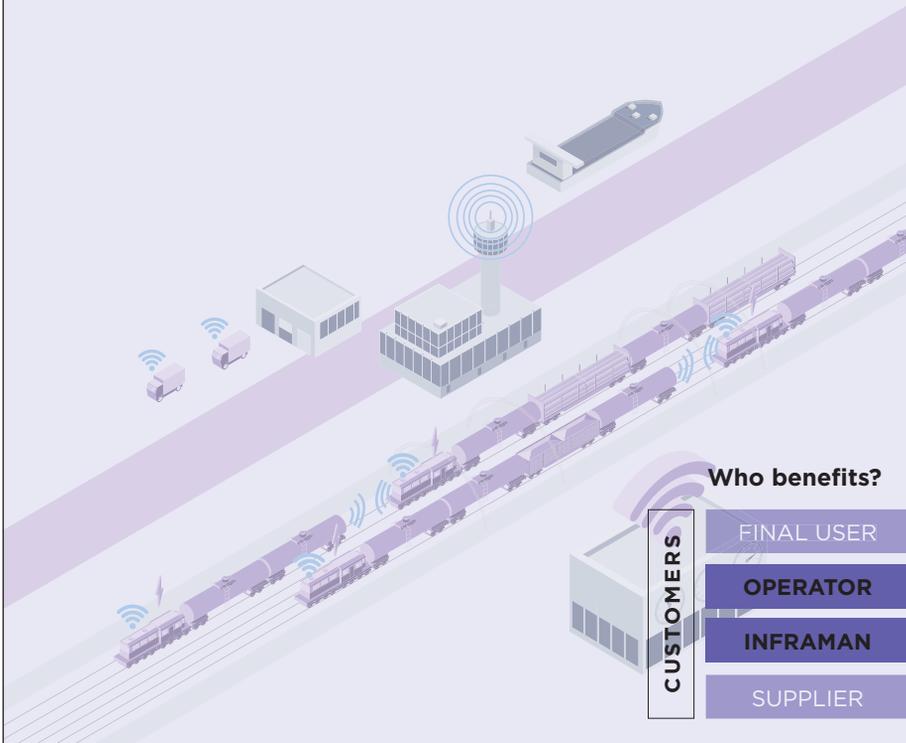
Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

Maintenance

- Reduce the maintenance cost of up to 10%**
- Increase the attractiveness** of rail mode for logistic operators
- Foster the generation of **new services** and **solutions for automated corridor operation**



44 Distributed Power for long trains

The distributed power for long trains solution will enable the possibility to increase the length of the trains focusing on radio remote controlled distributed power technology for freight trains.

Targeted market:

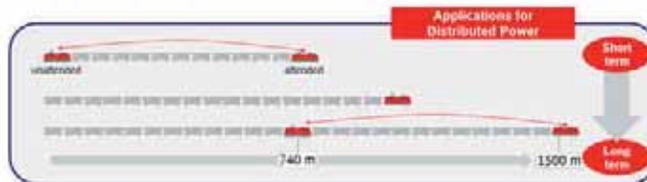
Mainly railway undertakings focussed on the growth of pan-European freight operations market

S2R Solution available for industrialisation:

End 2021

Market outlook:

Good perspectives for freight operators, infrastructure managers and railway undertakings



45 Full Electric Last Mile Propulsion

With this solution S2R develops a scalable electric last mile propulsion system that is capable to complement or replace existing last mile diesel engines.

Targeted market:

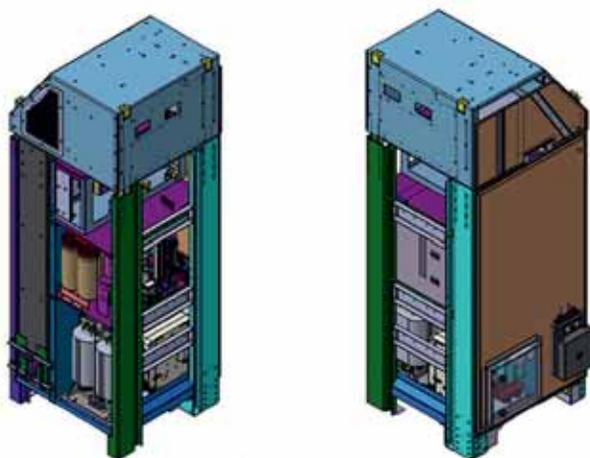
Mainly freight trains market, running into non electrified yards, harbours, but also passenger trains market running on non-electrified lines (diesel) with the need to enter sensitive areas, like underground stations

S2R Solution available for industrialisation:

2022

Market outlook:

Increasing, especially with the availability of low cost batteries



46 Battery module

With this solution S2R develops a scalable battery module for locomotive application based on automotive sector's battery cells considering the potential downsize of actual diesel engines and with the goal to target the market worldwide.

Targeted market:

Mainly freight trains market, running into non electrified yards, harbours, but also passenger trains market running on non-electrified lines (diesel) with the need to enter sensitive areas, like underground stations

S2R Solution available for industrialisation:

2022

Market outlook:

Increasing, especially with the availability of low cost batteries



BENEFITS

Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

Traction power

- ✓ **Productivity increase** of up to 100% by doubling train length up to 1,500 m
- ✓ Capacity increase by more **efficient usage of existing infrastructure**
- ✓ **Reduction of cost per unit**
- ✓ Significant **increase of competitiveness** for the sector
- ✓ **Punctuality increase** because there is no need to wait for external shunting services
- ✓ **Acceptance also in ecological sensitive environment**
- ✓ **Running in tunnels and stations, where exhaust gases are not allowed**
- ✓ **Energy savings** due to possibility to store braking energy in the last mile battery, **especially under DC networks and on non-electrified lines**
- ✓ **3x peak power compared** to Last Mile Diesel propulsion
- ✓ **More than 6x more installed energy** compared to existing electric last mile propulsion systems

Who benefits?

CUSTOMERS

FINAL USER

OPERATOR

INFRAMAN

SUPPLIER

47 Yard and Network management

The solution to efficiently manage yards and rail network will result in identifying the difficulties and shortcomings of a yard manager and provide improved algorithms and specifications. The tool provided to support decisions will increase automation in planning and traffic control tasks.

Targeted market:

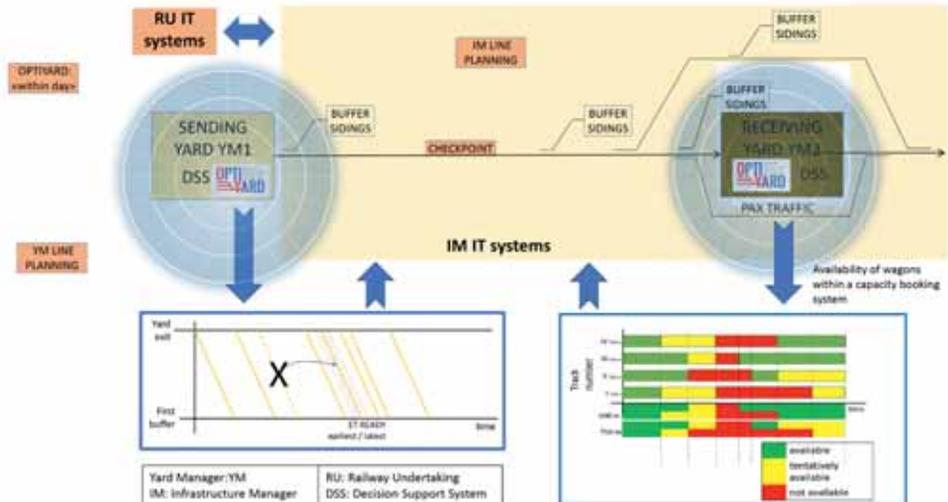
Mainly railway undertakings focussed on the growth of pan-European freight operations market

S2R Solution available for industrialisation:

Before 2023

Market outlook:

Good perspectives for freight operators, infrastructure managers and railway undertakings.



BENEFITS

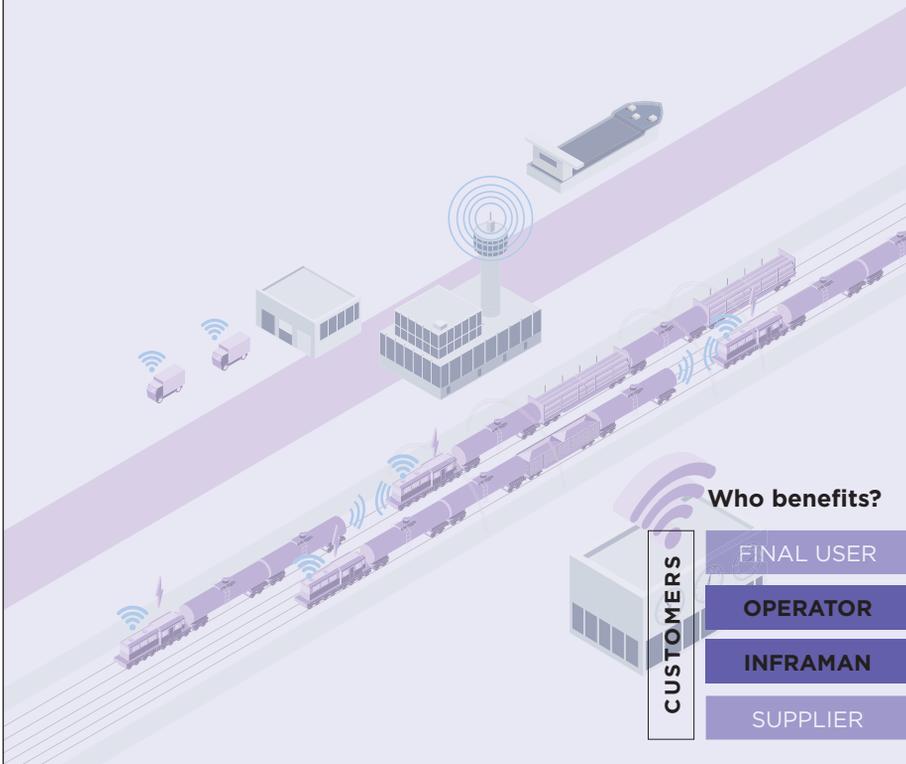
Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

Yard and Network management

- Capacity increase** by more efficient usage of existing infrastructure.
- Significant increase of competitiveness** for the sector.
- Foster the generation of new services and solutions** for the logistic chain.



48 Digital Brake Test

This solution will end up with the past 100 years obligatory brake test that has to be performed on freight wagons prior to departure by kicking the brake blocks. Thanks to this solution and to digital technology brake test can now be performed digitally.

Targeted market:

Mainly all European freight wagons market

S2R Solution available for industrialisation:

2022

Market outlook:

Standardisation between telematics suppliers necessary for an EU-wide deployment



BENEFITS

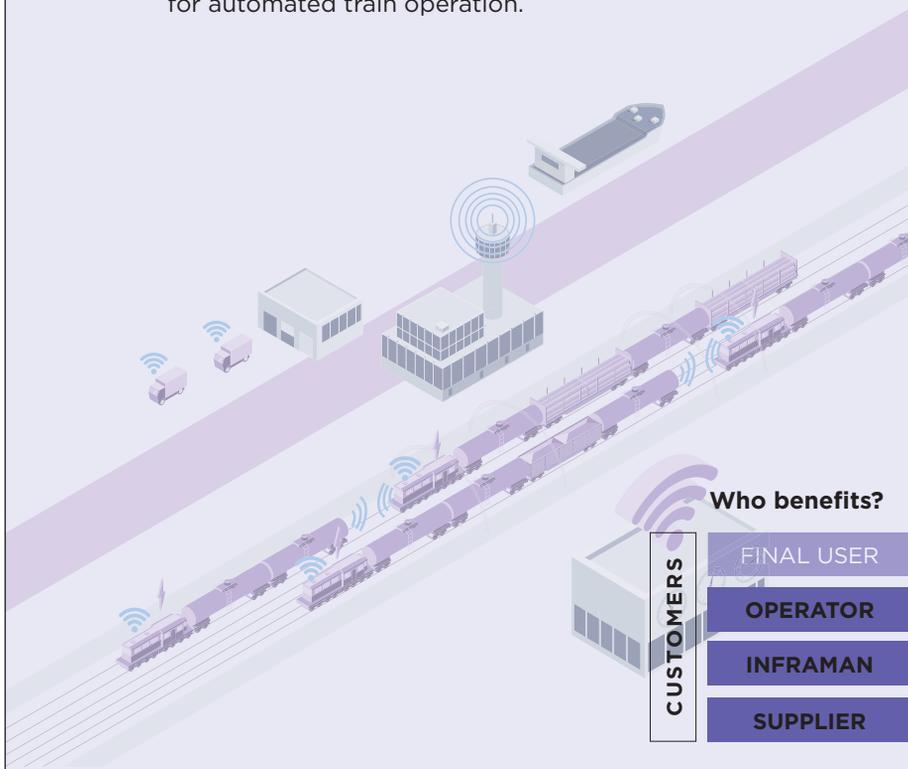
Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

Digital Brake Test

- Improved punctuality** as digital brake testing is twice as fast as conventional testing.
- Greater security** as the brake application and release are measured rather than checked manually.
- Staff security** by elimination of an arduous task for ground operative in a risky environment.
- Foster the generation of **new services** and **solutions** for automated train operation.



Who benefits?

- CUSTOMERS
- FINAL USER
- OPERATOR
- INFRAMAN
- SUPPLIER

49 Intelligent Video Gate

This solution will help to identify and verify incoming trains to marshalling yards automatically. The Intelligent Video Gate solution will automatise these activities at intermodal terminals, improving data quality and reliability of inbound processes with a significant impact on terminals' capacity.

Targeted market:

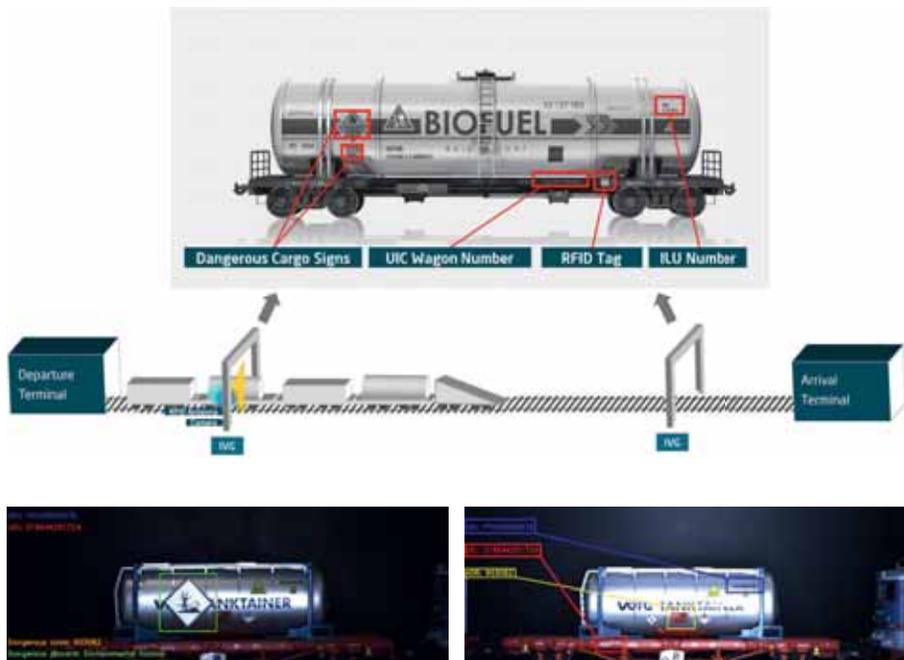
Mainly all European freight wagons market

S2R Solution available for industrialisation:

2022

Market outlook:

Good perspectives for terminal operators, railway infrastructure managers and railway undertakings



BENEFITS

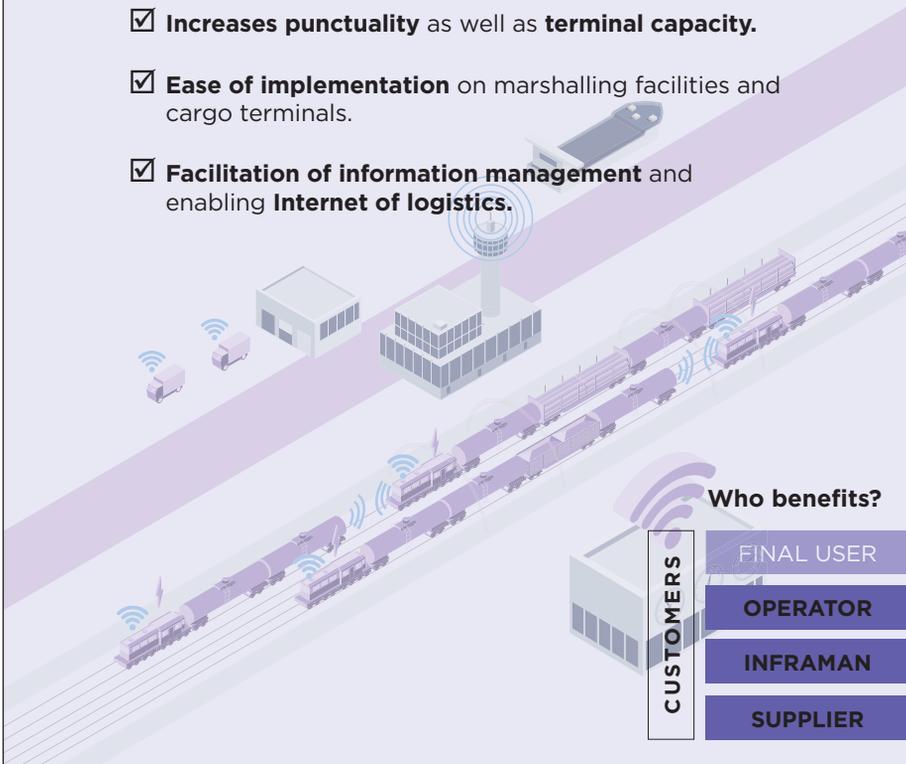
Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

Intelligent Video Gate

- ✓ Improved and **faster operational handling** and **reduction of manual and arduous work** of up to 20%.
- ✓ **Optimized operation** as information is collected in real time.
- ✓ **Faster** arrival and departure **processes**.
- ✓ Improvement of **information exchange** between terminals, infrastructure managers and railway undertakings.
- ✓ **Increases punctuality** as well as **terminal capacity**.
- ✓ **Ease of implementation** on marshalling facilities and cargo terminals.
- ✓ **Facilitation of information management** and enabling **Internet of logistics**.



50 Light Thermostable Wheel

This new solution will solve the load constraints and safety issues related to one of the most extensively used wheel at EU level and will enable safety increase, noise reduction emission as well as an increase on the load capacity.

Targeted market:

Mainly all European freight wagons using composite brake blocks

S2R Solution available for industrialisation:

2021

Market outlook:

Good perspectives for rolling stock owners and operators



51 Silent Wheelset

This new solution will contribute to reducing noise emission levels and foster a friendlier rail system. It will also increase the load capacity and minimise the societal impact of the increase rail freight operations transport volume foreseen.

Targeted market:

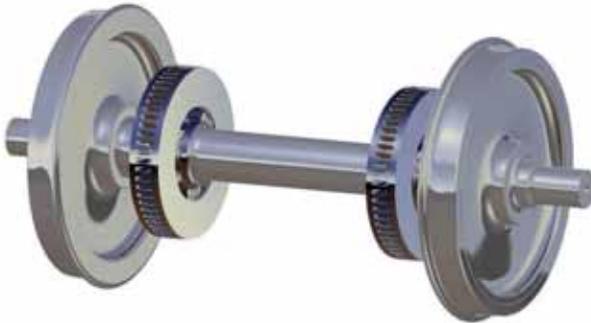
Mainly all European freight wagons market

S2R Solution available for industrialisation:

2021

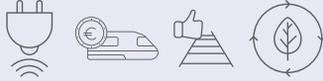
Market outlook:

Good perspectives for rolling stock owners and operators



BENEFITS

Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

Wagon

- ✓ **Increased load capacity per axle** up to 10% for European freight wagons
- ✓ **Light wheel design (339 kg)** allowing to increase load capacity in wagons
- ✓ **Safety is increased** thanks to a thermostable solution that reduces the risk of radial cracks on the rim
- ✓ **Noise reduction in the wheel emission up to 2 dBA** fostering class A “very silent wagons”
- ✓ **Compatible** with 205 and 215 mm diameter **ESFA axle wheelset standards**
- ✓ **Reduced wear** on the wheels, increased wheel life and I reduction of life-cycle costs.
- ✓ **Increased load per axle, from 22,5 to 25 Tn**



52 Extended Market Wagon

This light-weight, fast running and electrified wagon solution in block train operation will attract transports that today are carried on the road and will strengthen competitiveness of existing rail bound transports and therefore contribute directly to the overall goal to shift transports from road to rail. Wagon intelligence conducted by wagon on-board unit in combination with a safe train integrity system will lead to high availability and predictable, stable performance. Significantly lower noise emissions will minimise the societal impact of the increase rail freight operations transport volume foreseen.

Targeted market:

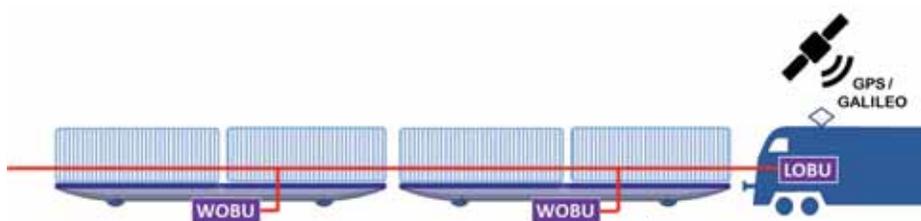
Mainly all European freight wagons market

S2R Solution available for industrialisation:

2022

Market outlook:

Good perspectives for Rolling Stock owners/operators



BENEFITS

Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

Extended Market Wagon

1. HIGHER PRODUCTIVITY

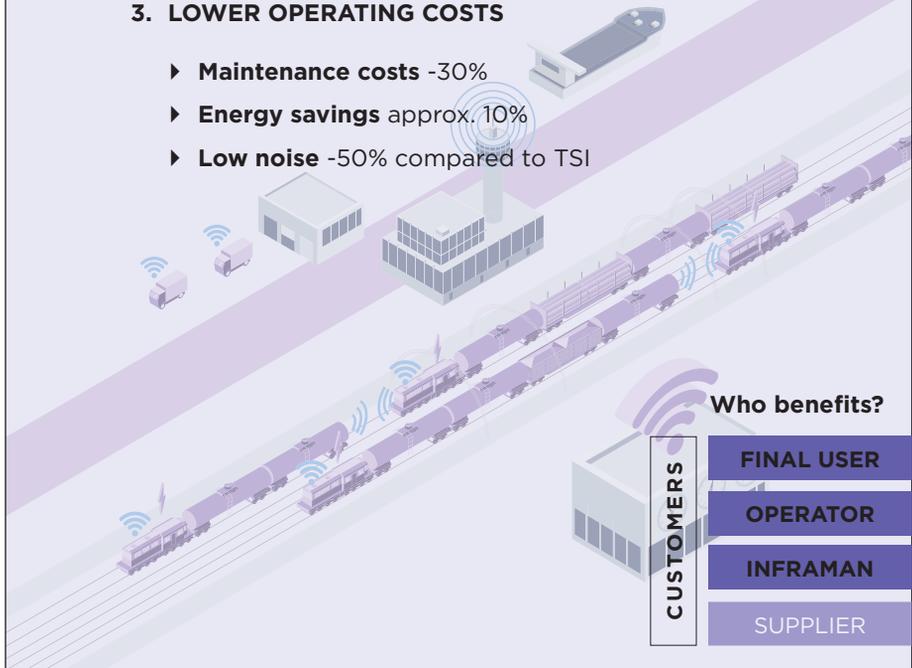
- ▶ **Significantly improved utilisation:** higher payload ratio due to lower tare weight (capacity increase)
- ▶ **Lower dwell times:** no shunting along the route

2. MORE FLEXIBILITY

- ▶ **Higher maximum speed** allows access to day routes (capacity increase)
- ▶ Aerodynamically optimised **low noise operation** - also in night times

3. LOWER OPERATING COSTS

- ▶ **Maintenance costs** -30%
- ▶ **Energy savings** approx. 10%
- ▶ **Low noise** -50% compared to TSI





Horizontal Innovative Solutions for Railway

Cross-cutting activities

Solution 53. Railway Interaction Simulation Model (PRISM)

Solution 54. Energy labelling of rail vehicles



Who benefits?

CUSTOMERS

- FINAL USER
- OPERATOR
- INFRAMAN
- SUPPLIER

53 Railway Interaction Simulation Model (PRISM)

The railway interaction simulation model solution will enable the simulation of large networks within a short runtime and lead to realistic results to improve planning and help decision-making in intraday planning and dispatching.

Targeted market:

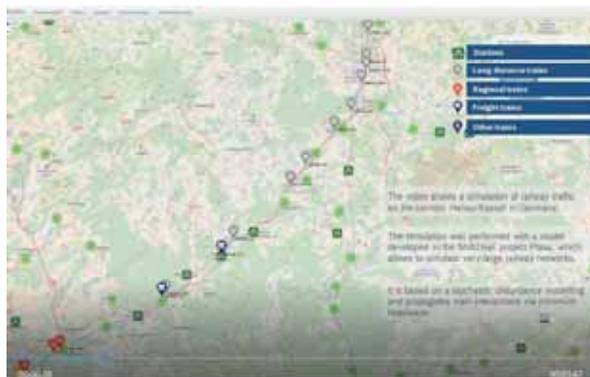
Mainly railway operating companies

S2R Solution available for industrialisation:

Before 2022

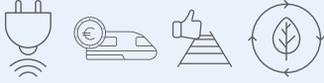
Market outlook:

Good perspectives for all market segment



BENEFITS

Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

Railway Interaction Simulation Model (PRISM)

- Capacity increase** to be expected due to fewer conflicts resulting from better planning
- Cost efficiency because of **optimization of decisions** in mid-term planning and timetabling
- Punctuality increase due to **improved timetables** and potentially optimization of decisions in operational planning and dispatching
- It will foster the generation of **new services** and **solutions for railway planning**



Who benefits?

CUSTOMERS	FINAL USER
	OPERATOR
	INFRAMAN
	SUPPLIER

54 Energy labelling of rail vehicles

The solution to propose an energy labelling for rail vehicles will result in the alignment with the energy standard EN 50591 and with the review of existing energy label in different sectors.

Targeted market:

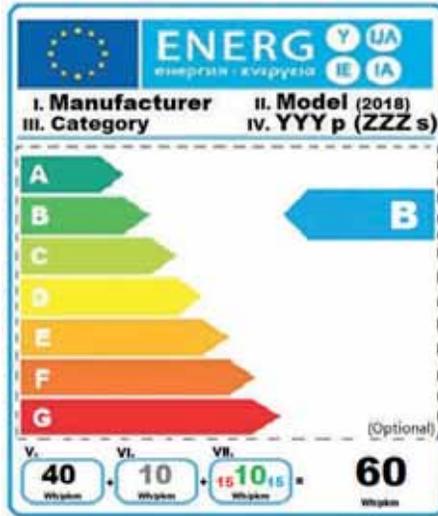
Mainly for end customers, train operating companies, transport authorities, homologation authorities and train manufacturers

S2R Solution available for industrialisation:

Before 2024

Market outlook:

Good perspectives for all market segment



BENEFITS

Contributes to the following future rail capabilities (see page 11 for reference)



Potential benefits and market impact

Energy labelling of rail vehicles

- Support the **development of more energy efficient rail vehicles**
- Encourage improvement of **CO₂ efficiency** in the transport sector
- Reduce energy costs** and rail system life-cycle costs
- Raise awareness** of stakeholders, including potential passengers and transport buyers
- Contribute to **rail attractiveness** and a shift to rail



Who benefits?

CUSTOMERS	FINAL USER
	OPERATOR
	INFRAMAN
	SUPPLIER



Founding Members



Associate Members



Competitive Freight Wagon Consortium (CFW)



DIE BAHNINDUSTRIE

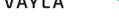
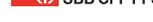
Virtual Vehicle Austria consortium+ (VWAC+)



Smart DeMain (SDM) consortium



European Rail Operating community Consortium (EUROC)



AERFITEC



SwiTracken consortium



TATA STEEL



Smart Rail Control (SmartRaCon) consortium



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