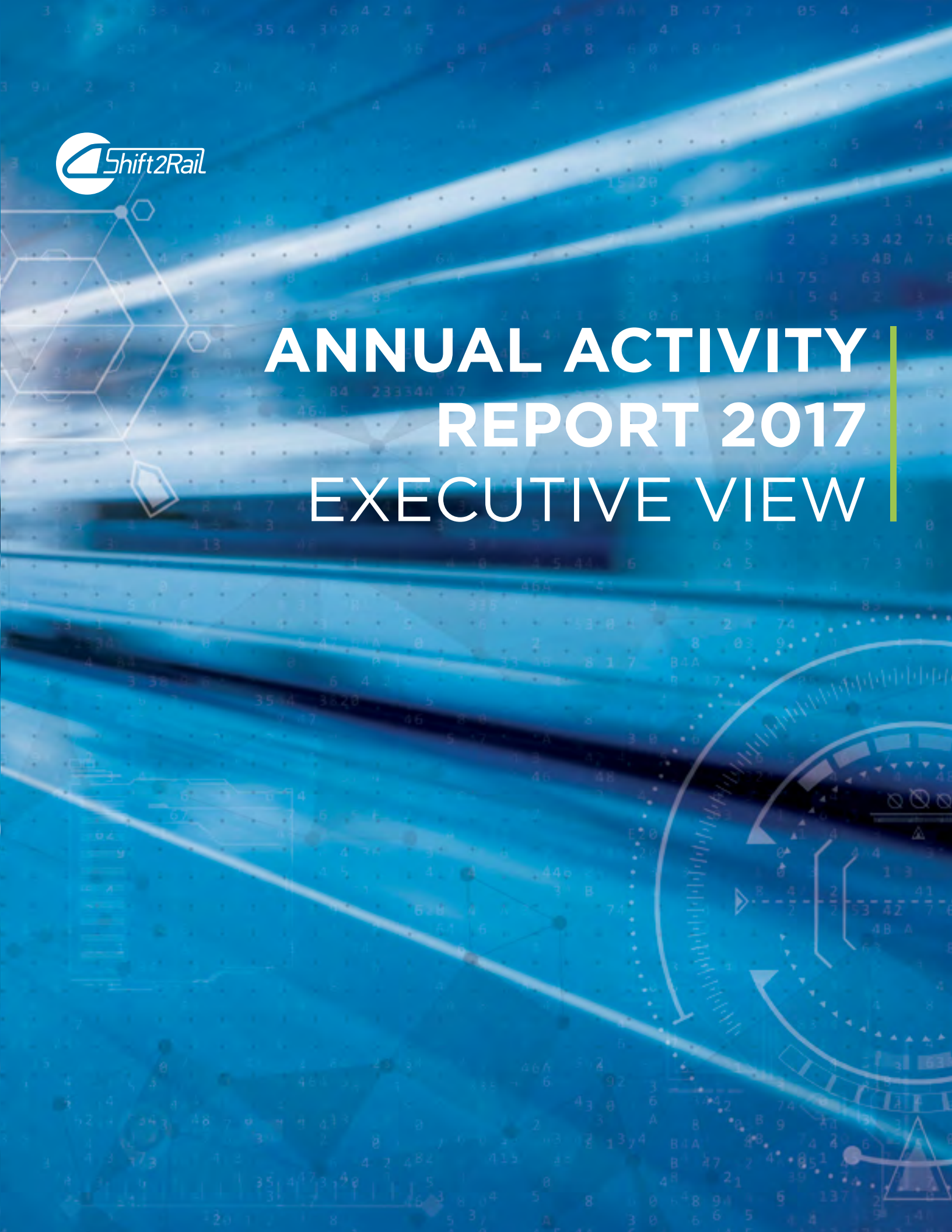

ANNUAL ACTIVITY REPORT 2017
EXECUTIVE VIEW

ANNUAL ACTIVITY REPORT 2017

EXECUTIVE VIEW

A full version of the Annual Activity Report 2017 is available here:

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“The S2R Programme is the opportunity to deliver to European citizens the benefits of “disruptive change”, toward a user-centric railway system that excels itself, to connect people, regions, and business.”

SHIFT2RAIL RESULTS 2017

Executive Director | Carlo M. Borghini

Digitalization, automation and the rapid development of new technologies are unlocking a radically different approach to mobility, creating the opportunity to capitalise on the strengths of railway systems by integrating them with services covering the first and last mile, for sustainable, seamless and integrated mobility.

'Delivering' has been the buzzword in the Shift2Rail Joint Undertaking (S2R JU) during 2017. Grounded in the strong support and commitment of its Founding Members, together with the Associated Members and other participants, Shift2Rail has consolidated its R&I activities and is about to deliver its first results– bringing Europe one step closer to the railway systems of the future.

But focusing on delivering as such is not sufficient: the new Multi-Annual Action Plan – Executive View has been adopted by the Governing Board in 2017. It provides a renewed mission oriented S2R Vision. Central to this vision is putting the customer in charge. The S2R Programme is the opportunity to deliver to European citizens the benefits of "disruptive change", toward a user-centric railway system that excels itself, to connect people, regions, and business.

The MAAP – Executive View contains also the first catalogue of 12 Innovation Capabilities which enable the sector to produce value-adding products and services: they have digitalization, automation and sustainability at their core.

To achieve this Vision, the R&I activities performed in the S2R Programme need to be integrated with national initiatives and vice-versa. It is only through the joint effort of researchers, engineers, and technicians around Europe, and beyond, that bringing together ideas, challenges and opportunities make the system transformation happening.

During 2017, the first results of the S2R's Innovation Programmes, such as 'train-to-ground' wireless communications, automated trains GoA2, smart energy-metering, inter-modal freight shunting prototypes, etc. have been released.

These results come from the 48 Shift2Rail Initiative and Programme projects; their outcomes contribute to developing innovative solutions that will increase the quality, reliability and punctuality of rail services while also reducing costs and facilitating cross-border travel; largely they target R&I at a low/mid TRL Level.

A modal shift from road to rail of travellers and freight will help Europe harness immense opportunities and overcome major challenges such as climate change, pollution and urban congestion.

Together with around 350 stakeholders across Europe, the S2R JU is committed to contribute delivering the railway systems of the future, enhancing the competitiveness of the European rail sector in various key areas, products and systems solutions, skills, new markets and performance, for the advancement and prosperity of its regions and citizens.

2017 MILESTONES

APRIL 2017

S2R JU Projects went through the **first Control Gate**, a systemic and integrated in depth review of the R&I activities: the Programme is on track but it requires more focus and prioritization.

JUNE 2017

S2R JU **awarded and signed grants** for a total value of EUR 110.9 million (17 grants: 7 to Members and 10 Open Calls).

Launch of the "**Invitation of the AM** to submit an answer in view of the realignment of their activities and additional commitment to the S2R Programme".

OCTOBER 2017

The S2R Governing Board **adopts the new Multi-Annual Action Plan** – Executive view, which outlines the S2R Vision and brings the final user at the centre of the R&I work to be performed

DECEMBER 2017

Signature of the contract for the Human Factor tender, total amount: EUR 0.2 million.

Shift2Rail hosted an **Information Day** where its Call 2018 for R&I activities was announced.

CALL 2017 IN FIGURES

* S2R co-funding € 60.1 M

OPEN CALLS
€ 19.5 M
(S2R funded)

CALLS FOR MEMBERS
€ 91.4 M
(S2R co-funding € 40.6 M)

17 PROJECTS
for a total value of
€ 111 M

200
PARTICIPANTS

10
OPEN CALL
PROJECTS

50
SMES

THE S2R PROGRAMME

Innovation Programmes

The S2R Programme is an integrated set of Research and Innovation (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.

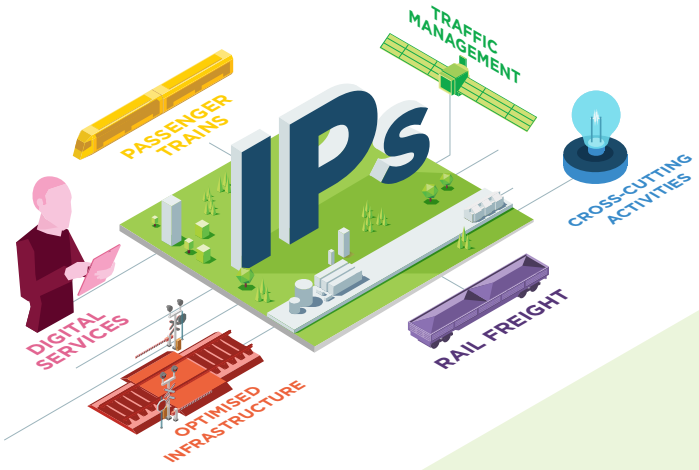
Within each IP, researchers develop a number of innovative technologies and solutions, called Technical Demonstrators (TDs). In this publication, we show the progress achieved in 2017 for each TD, which are the building blocks for advancing each Innovation Programme.

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.

Shift2Rail is implementing a coordinated R&I strategy to ensure that innovative solutions coming from its IPs will contribute to a major railway systems' transformation, – a common strategy for rail research and innovation in Europe.

The four 'lighthouse projects', launched by the European Commission as part of the Shift2Rail initiative during its ramp-up phase in May 2015, set the basis for more efficient rail vehicles, infrastructure management, travel planning for customers and modern solutions to help rail freight reach a higher market share, taking heavy loads off Europe's congested roads.

The first projects managed by the Shift2Rail Joint Undertaking started at the end of 2016. In 2017, they were complemented by the R&I activities started in September and, together, move forward the Programme towards delivering the railway systems of the future, as the backbone of European mobility.



MAIN RESULTS OF SHIFT2RAIL RESEARCH & INNOVATION IN 2017

Definition of the initial requirements for the next generation of TCMS, functional architecture principles for functional open coupling and Drive by Data concept and technology. Software specification for 'train to ground' systems and laboratory validation of **Long-Term Evolution (LTE) technology for wireless communication between consists and between trains**. Creation of a Demonstrator for connected trams, moving in a coordinated manner and allowing for some remote control features.

Designing and prototyping components in Silicon Carbide (SiC) in the full traction system. For regional trains, components including SiC could make parts consume up to 20% less energy and have 20% less maintenance cost and 15% improvement of reliability. SiC-based traction will also make trains quieter and more efficient.

Definition of functional requirements for high Safety Integrity Level (SIL) electronic solutions for brake control and for the future architecture of a **distributed electronic brake system**. Test procedures started for wheel slide protection.

Definition of operational requirements and issue of a first set of **specifications for Automatic Train Operations (ATO) semi-automated trains over ETCS.** Shift2Rail expects to have pilot tests running for its implementation by 2019 for Grade of Automation 2, and by 2022 for fully automated trains in mainline.

Start of the study and design of a canonical data model and definition of algorithms and approaches for standard open interfaces, anomaly detections, process mining and predictive decay related to the railway assets, through new live-monitoring solutions for **intelligent asset management** and execution strategies.

Creation of a **proof of concept for smart energy metering** in rail systems. Solutions for energy management are being tested on trams in Reims, France.

Creation of the **a preliminary architecture of a software eco-system** based on semantic technology that supports the interoperability of rail with other transport modes by allowing transport service providers to share and access data in different formats, without the need to change their legacy systems. This will allow passengers to book multi-modal trips from their devices with a single click.

Analysis of common standards and best practices in **cyber security** from several organisations across the world to identify the most efficient norms - a first step towards a **'secure-by-design standard'** during the development of railway components and solutions.

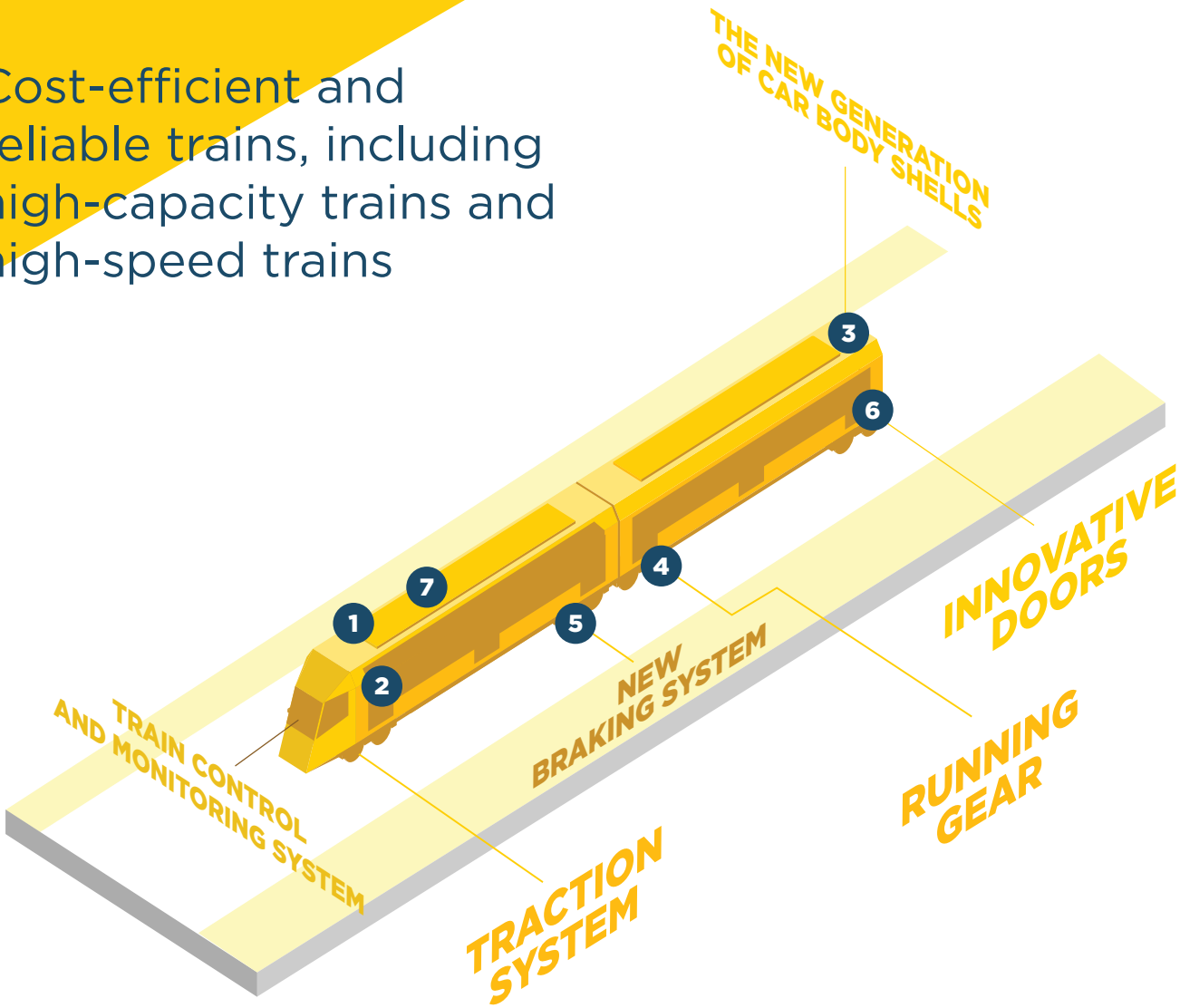
Development of accurate methods for **inspection of bridges and tunnels** using Digital Imaging for Condition Asset Monitoring & innovative remote sensors systems, with BIM-based asset management methods for remaining life estimation, bridge prediction behaviour, and exploration of bridge dynamics. The already performed in-vivo tests estimate reduced possession time for inspection & repair by 25-40% and reduction of inspection cost by 20%.

Definition of functional and technical requirements for the **Intelligent Video Gate** for high-speed identification of content in freight wagons and creation of the first **hybrid-shunting prototype**. Both technologies will lead to automation of freight terminals.

PASSENGER TRAINS

IP1

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



1. **New traction systems,** the 'engine' of the train.

Partners have defined the first set of high-level specifications for Silicon Carbide (SiC)-based traction systems and started developing SiC-based traction components for tramways and other train systems.

Research has revealed that the integration of SiC components in regional trains' traction systems could lead up to 10% reduction of energy consumption, 20% less maintenance cost and 15% reliability improvement for these parts. SiC-based traction will also make trains quieter and more efficient.

2. The next generation of **Train Control and Monitoring System (TCMS)**: to enable higher traffic by overcoming bottlenecks caused by physically coupled trains.

Engineers have defined the initial requirements for the next generation of TCMS, the functional architecture principles for functional open coupling, and the Drive by Data concept and technology. They have also written the software specification for 'train to ground' communication systems and validated in the laboratory the use of LTE technology for communication between consists and between trains. A demonstrator for connected trams, moving in a coordinated manner and allowing for some remote control features has been developed.

3. New **car body shell** designs have been conceived in 2017, looking at new materials such as aluminium extruded profile and composite sandwich. New concepts of car body shells could reduce the structure's weight up to 20% for urban vehicles and up to 16% in high-speed trains. Vehicles will have higher passenger capacity, be more efficient and have less impact on the tracks.

4. Partners have developed a cost-benefit analysis to test new possible **running gear** designs. Based on this model, researchers will develop smart solutions for running gear, with functions such as health monitoring, active suspension systems, and the implementation of innovative sensors, new materials and manufacturing technologies.

5. As a preliminary step to research on **new braking systems,** researchers have reviewed the current legal framework for authorisation and standards for these parts and defined functional requirements for high Safety Integrity Level (SIL) electronic solutions for brake control. Test procedures for Wheel Slide Protection and a definition for the future architecture of a distributed electronic brake system have been released too.

6. Work is in its preliminary phase for implementing composite materials in **doors and access systems** in order to reduce dwell time and increase line capacity.

7. Operators demand **train modularity** so they can adapt the interior layout depending to their changing needs, optimising capacity and dwell times. Preliminary research has analysed public perception on comfortable and attractive train interiors as well as existing requirements for interior design. First conclusions indicate a metric to measure comfort in trains could be developed, and areas that would benefit from a rationalisation of standards would be passenger safety in a crash or passive safety; by vandalism resistance; methodology to measure seating comfort; and passenger information systems.

TRAFFIC MANAGEMENT

IP2

Advanced Traffic Management and Control Systems

1. An **'adaptable wireless communication system for all rail systems'**. Studies focus on migrating from current GSM-R to LTE, Wi-Fi or satellite-powered alternatives open to further developments, providing enhanced safety and security and resilient to interference.

In 2017, Shift2Rail has defined the user and system requirements for 'train to ground' communication to set the foundations for a rail-specific wireless system, capable of transmitting signalling and critical voice, data and video information. Thinking ahead, researchers have also produced a set of optimal scenarios for the future 'train to ground' communication system.

2. **Automated Train Operation'** (ATO) aims to allow driverless trains to run on ETCS reaching a level of full automation (GoA 4). This will help to increase the efficiency of all railway lines: mainline, high speed, urban, light rail, regional and freight lines.

This TD has defined the operational requirements and issued a first set of specifications for ATO semi-automated trains (GoA 2), a major achievement for 2017. Shift2Rail expects to run pilot tests by 2019 for the implementation of GoA 2, and by 2022 for fully automated trains in mainline.

3. Work on **'Moving Block'**, a system that decouples signalling from the physical infrastructure, is in its preliminary phase, as researchers are developing the system's specifications, based on different possible scenarios. Moving Block removes the constraints imposed by trackside train detection, thereby allowing more trains on a given main line.

4. **'Safe Train Positioning'** will develop a fail-safe, multi-sensor train positioning system, applying Global Navigation Satellite Systems (GNSS) technology to the current ERTMS/ETCS core. It will boost the quality of train localisation and integrity information, while also reducing overall costs, in particular by enabling a significant reduction of trackside detection systems. Work on the specifications for this technology started in September 2017.

5. An innovative on-board **'train integrity'** solution is able to detect when a wagon detaches and loses its physical connection with the locomotive and provide it with power, on freight and low traffic lines.

Shift2Rail is developing the technology's concept and architecture specifications as well as specific solutions for power supply. Train integrity systems include autonomous train-tail localisation, wireless communication between the tail and the front cab, safe detection of train interruptions and autonomous power supply functionality without the deployment of any fixed trackside equipment.

6. A **'new laboratory test framework'** will comprise simulation tools and testing procedures to minimise on-site testing, allowing remote connection of different components located in distant labs. Work in 2017 has focussed on analysing the state of art of zero on-site testing methods and definition of requirements and boundaries for their development.

7. The development of a set of **'standardised engineering and operational rules'** will also facilitate the verification and authorisation processes. Work on this point started in September 2017.

8. **'Virtual Coupling'** will enable 'virtually coupled trains' to operate much closer to one another and dynamically modify their own composition on the move -virtually coupling and uncoupling train convoys. Its development will start in 2018.

9. An optimised **'Traffic Management System'** will include automated processes for data integration and real-time exchange with other rail business services, improving operations thanks to a scalable and interoperable communication system. Researchers work on designing a scalable and interoperable 'data layer' to enable data exchange between rail and other modes and services.

10. Shift2Rail is developing **smart radio-connected wayside objects**, able to connect among themselves and with control centres, communicating devices in the area and train on-board units, providing opportunities for cost reduction and improving asset and network information management.

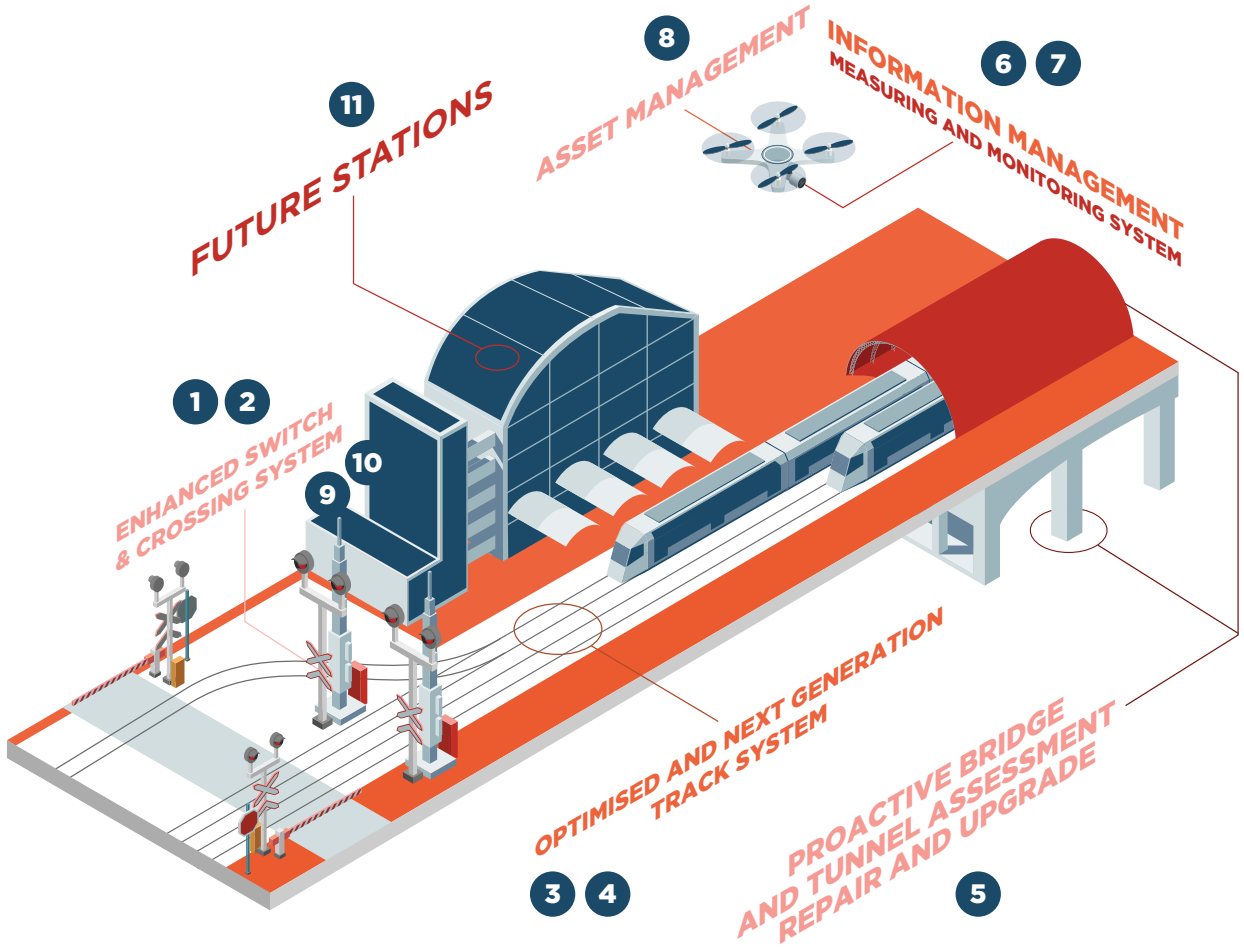
Shift2Rail has analysed the state-of-art of wayside objects and their economic benefits. Partners are analysing the requirements and standards as well as developing the system's architecture, including specific solutions for autonomous energy harvest.

11. Enhanced **Cyber Security** technologies are also under development. Researchers have analysed common standards and best practices in cyber security from several organisations across the world to identify the most efficient ones. The result of this study will set the foundations to develop a railway dedicated 'secure-by-design standard' , which is to be taken into account when developing new components.

OPTIMISED INFRASTRUCTURE

IP3

Cost-Efficient and Reliable High-Capacity Infrastructure



1. **'Enhanced Switch & Crossing System'** aims to improve the operational performance of existing switch and level crossing designs. First studies have identified the best devices in use, and researchers now focus on system design and testing.

2. The **'Next Generation Switch & Crossing System'** aims to provide radical, novel system solutions that deliver new methods for directing trains to change tracks. Shift2Rail scanned new design concepts and assessed new materials and manufacturing techniques such as 3D printing.

3. The **'Optimised Track System'** challenges track construction assumptions currently implicit in track design and explores how innovative products, processes and procedures can provide higher levels of reliability, sustainability, capacity and life cycle-cost savings.

Researchers have developed a test on pre-deforming to obtain information on deformations on railhead material on tracks. Other fields of research include rail damage mechanisms and preventive measures as well as enhanced slab track solutions and use of elastomers.

4. The **'Next-Generation Track System'** aims at drastically improving the performances of track systems, targeting a period some 40 years beyond the present state of the art. To do this, research focusses on long-term needs of railways and possible solutions to meet them.

In 2017, this TD focussed on identifying radically new track systems and concepts for ballasted and slab tracks, as well as transition zones. First, projects identified state-of-the-art hybrid track solutions – a benchmark for assessing next generation track designs. Research also identified the feasibility of a novel discrete defect repair technology, to be examined further.

5. The **'Proactive Bridge and Tunnel Assessment, Repair and Upgrade'** is to improve inspection methods and repair techniques to reduce costs, improve quality and extend their service life –while reducing of noise and vibrations.

In 2017, partners started the development of accurate methods for inspection of bridges and tunnels using Digital Imaging for Condition Asset Monitoring and innovative remote sensors systems, with BIM-based asset management methods for remaining life estimation, bridge prediction behaviour, and exploration of bridge dynamics. The already performed in-vivo tests estimate reduced possession time for inspection and repair by 25-40%, and reduction of inspection costs by 20%.

Considerable progress has been achieved in the areas of tunnel inspection, bridge assessment and implementation of bridge technology while certain difficulties were faced concerning the enhanced repair of tunnels and upgrade of bridges.

6. The **'Dynamic Railway Information Management System (DRIMS)'** aims to define an innovative system for the management, processing and analysis of infrastructure data. In 2017, projects began the study and design of a canonical data model and defined algorithms and approaches for standard open interfaces, anomaly detections, process mining and predictive decay related to railway assets.

7. The **'Railway Integrated Measuring and Monitoring System (RIMMS)'** will provide innovative tools and techniques to collect in formation on the status of assets in a non-intrusive and fully integrated manner.

Researchers developed switch and track geometry live-monitoring solutions, gathering data from unmanned vehicles, in addition to monitoring signalling systems and assessing the impact of rolling stock on infrastructure. Partners also developed systems for monitoring stress-free temperature in track and switches. Future work will include the use of satellites to detect risks from natural events, such as floods or ground movements.

8. The vision of the **'Intelligent Asset Management Strategies (IAMS)'** is to use data from other TDs to develop a single environment for asset management, deploying collected and processed data.

Researchers developed intelligent asset management and execution strategies, supporting maintenance efficiency. Promising results in this area include a new lean tamping process, a technique to pack the ballast under the track, making rails more durable while eliminating the traffic disruptions for maintenance purposes.

9. Engineers have produced basic designs and specifications for an intelligent power substation that will be connected with public grids and traffic and maintenance management systems –enabling a **'smart power supply'**.

10. The objective of the system for **'Smart Metering for Railway Distributed Energy Resource Management'** is to achieve a fine mapping of real time energy flows within the entire railway system, as the basis for any energy management strategy.

Research has defined the basic design of the system and implemented a smart metering proof of concept in a Reims' tramways, in France. Solutions for energy management are being tested on-board a tramway and on ground in one traction substation in Reims. Analysis of this data is now ongoing.

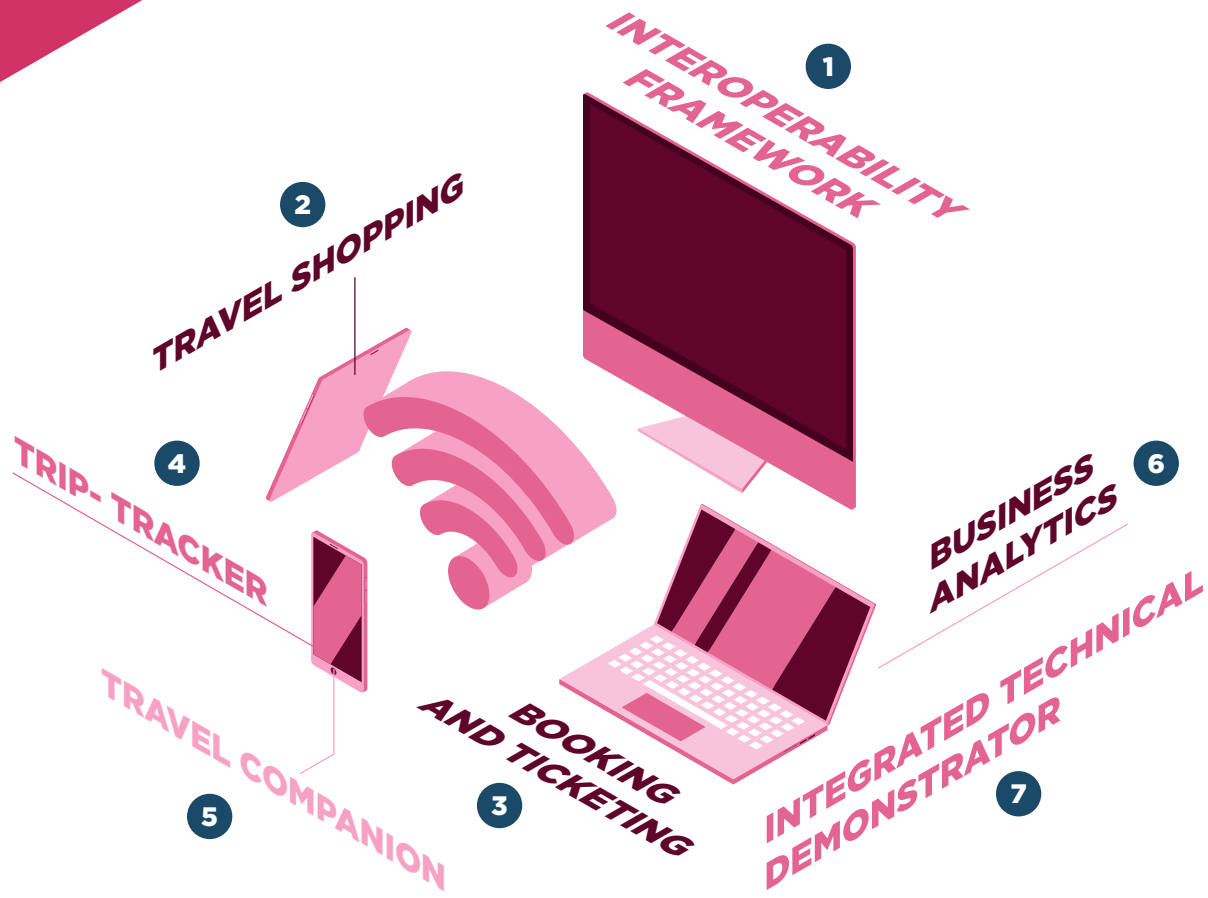
11. **'Future Stations'** will provide better customer experience mainly through improved security and capacity in large stations, and standardised designs for more efficient small stations.

First research activities in this field focus on improving passenger flows between platforms and concourse, accessibility and designing emergency strategies for major stations.

DIGITAL SERVICES

IP4

IT Solutions for Attractive Railway Services



1. The **'Interoperability Framework'** is a key technology enabler for a complete transformation of the European transportation ecosystem. A semantic based software system that supports the interoperability of rail with other transport modes by allowing transport service providers to share and access data in different formats, without the need to change their legacy systems. In 2017, projects have generated and tested components for semantic technology and data models in order to help the ecosystem retrieve information directly from the different operators and process it as part of multimodal trips offered to customers.

Partners are adapting the system to comply with the data protection rules at European, national and regional levels.

2. **'Travel Shopping'** is building a one-stop-shop capability, pulling information from the 'Interoperability Framework' to offer multimodal trips to consumers.

In 2017, expert groups started working on guidelines for facilitating market uptake, taking into account both legal aspects and end-user demands. Work is ongoing on the specification of actors, capabilities, use cases and architecture of the system.

3. **'Booking & Ticketing'** will orchestrate interactions among booking, payment and ticketing engines, including the rollback activities, crucial in case a transaction fails. This will radically simplify travellers' lives and complexities of 'behind-the-scenes' such as multiple booking, issuing, payment and ticketing processes.

In 2017, engineers developed the specifications, ontology and glossary documents covering the 'shopping' and 'ticketing' functionalities. Several Transport Service Providers (TSPs) have been incorporated to the ecosystem covering different transport modes such as air, coach, bus and train and integration tests have been executed with them.

The TD has also defined travel rights and their terms and conditions, which are to be automatically applied in case of disruption. Ancillary and after-sales services have also been introduced to the system, as well as different payment modes.

4. The **'Trip-tracker'** will offer travellers personalised information and updates on their journey. In case of disruption, the system will provide the passengers with updated booking alternatives along with updated virtual transport tickets.

Researchers have developed a preliminary architecture of the system able to identify the relevant situation in each mode and their impact on a given trip as well as to interact with the 'booking & ticketing' and the 'trip tracker' technologies to offer automatically the best alternatives in case of disruption.

Since this TD analyses traveller-centred decision factors, an Advisory Board with relevant experts was established attaching high importance to data protection and ethical standards.

5. The **'Travel Companion'** will provide an interaction centre for travellers and transport providers, where it will be possible to access a wide range of personalised travel services on the go. The software's core was close to its release by the end of 2017. Engineers work to add new features to this core platform, such as an analysis of customer decision factors and the integration of the 'trip-tracker' functions.

6. **'Business Analytics'** will provide common business intelligence guidelines for all products and services of transport providers based on the access to the open-ended web of transportation data offered by the Interoperability Framework.

Researchers have developed data analysis and management tools, compiling metrics such as ongoing events in a location, weather forecasts and social media messages. Currently, they are assessing which other indicators will be useful for providers to constantly improve their services, while respecting the European data regulations.

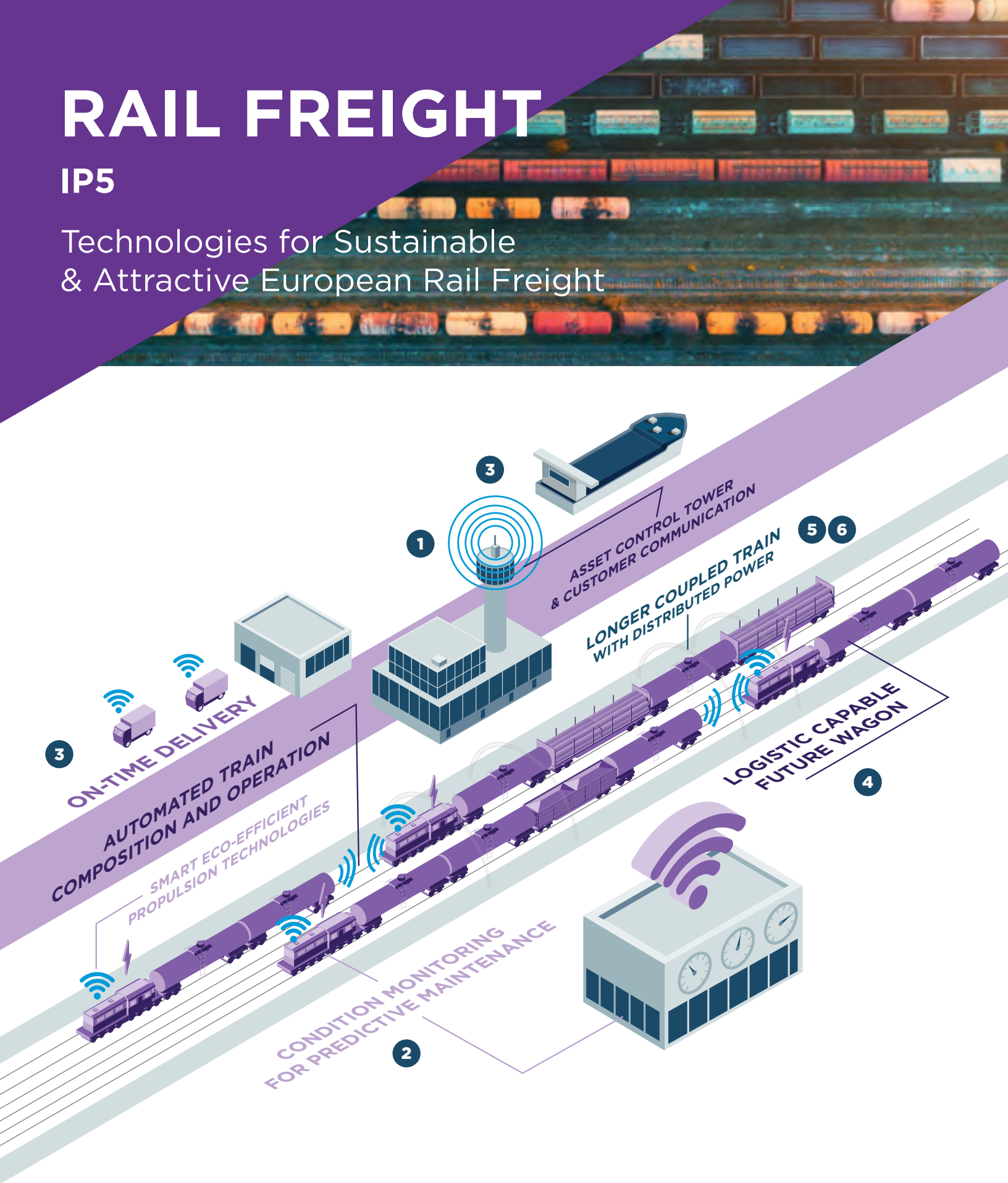
7. The **'Integrated Technical Demonstrator'** will act as a coordinator of all the other TDs, aligning their achievements in order to deliver the IP4 IT ecosystems more effectively.

First developments include management and organisation rules to be shared by the partners, with the aim to offer robust and tailored means of monitoring and control of the work progress.

RAIL FREIGHT

IP5

Technologies for Sustainable
& Attractive European Rail Freight



1. **'Implementation Strategies and Business Analytics'** ensures that IP5 develops technologies in line with market needs. Researchers produce migration plans for implementing new technology solutions on a large scale, identifying market segments and developing specifications and Key Performance Indicators for freight.

In 2017, work has focussed on producing an overview of all relevant segments of the rail freight market, focussing on technical and logistical challenges. Studies in 2017 listed market drivers, current technologies and requirements for cargo condition-based monitoring, wagon design and predictive maintenance.

Findings from this analysis showed that supply chains have become more complex and sophisticated requiring innovative services. New wagons should be more widely standardised and based on modular designs. Moreover, market trends indicate that there is a great demand and potential uptake for intelligent lightweight freight wagons, able to carry high-value, low density and time-sensitive goods.

2. **'Freight Electrification, Brake and Telematics'** targets the adoption of two global megatrends for freight rolling stock: automatic coupling and digitisation of rolling stock.

As part of the digitalisation efforts, engineers reviewed in 2017 the architecture, components, feedings and maintenance tasks for freight trains as a basis to develop condition-based and predictive maintenance processes, fed by information provided by sensors located in different parts of the train. Results from the tests on a locomotive type BR 189 indicated that the top 10 components account for a large percentage of the total costs.

Another area of research carried out in 2017 showed the advantages of a system based on an autonomous self-powered wireless sensor network for freight digitalisation. This technology could help freight trains to overcome issues of sensor wiring and power supply.

To explore the possibilities of automatic coupling, researchers produced an exhaustive report on existing wagon-coupling systems and produced a preliminary list of technical requirements for further implementation of this technology in Europe.

3. **'Access and operations'** is developing digitised processes to optimise service planning and operation thanks to real-time data gathering, steering, operation and coordination of intermodal transport at higher speed. This supports better use of available capacity by improving the access and operation of local hubs, essential but cost-intensive subsystems for rail freight business.

To acquire a common understanding of the decision-making and processes in logistic nodes, researchers analysed and classified marshalling yards and terminals into different categories.

As a real case study, they produced an analysis of operational processes in marshalling yards in Germany and Sweden, revealing that a predictive system to inform decision makers in the yard on the consequences of possible actions could make their work more efficient.

4. A report on new running gear and **'wagon designs'** is due for publication in early 2018. After having reviewed the current state of the art, engineers produced new designs for wagons and carried out simulations to assess their performance.

Novel designs for 'terminals, hubs, marshalling yards and sidings' will help to improve intermodal freight operations. Research is ongoing for two crucial technologies in the development of inter-modal terminals: the 'intelligent video gate', able to recognise and transfer incoming and outgoing wagon data and 'hybrid' shunting fleets, able to operate in different transport modes.

Partners have analysed the state of the art, created the first technical requirements for the 'intelligent video gate', and created the first prototype for hybrid shunting devices.

5. Researchers are developing **new freight propulsion concepts** such as eco-efficient hybrid systems for the last mile and distributed power systems to enable longer trains. They are also exploring how to improve the overall performance of current locomotives.

Partners analysed different transport models based on Li-Ion batteries and hybridisation concepts. Based on this study, they are currently developing a demonstrator for full electric last-mile propulsion systems.

In 2017, researchers defined the specifications for safe radio-controlled traction and braking systems for double trains of up to 1500m, where a single locomotive controls two synchronised vehicles. A model for long train simulations has been developed, too.

An updated modern bogie design is another field to which IP5 is contributing. After a benchmarking exercise, engineers identified the best specifications, presenting the lowest wear and noise emissions. Researchers analysed the use of light materials in bogies to go beyond the current state of the art. New designs could lead to a reduction of 43% in bogie mass, which translates into 12.5% less track damage and 5% less energy consumption.

6. Partners conducted a socio-economic overview and produced freight specific operational requirements specification for 'autonomous train operation' (ATO) in Europe as this will be the basis for the operations of **Autonomous trains**.

Studies for automatizing freight rail included the definition of different parameters to reduce energy consumption in rail freight and algorithms for more energy-efficient operations, in synergy with IP2 projects on ATO.

As part of these efforts, partners are developing a set of requirements and specifications to develop an obstacle detection system.

CCA – CROSS CUTTING ACTIVITIES

CCA

1. Partners are carrying out **research on the long-term needs and socio economic goals,** to which the rail system is expected to contribute. To assess the extent to which these goals are met, working groups are defining a series of indicators and methods.

This analysis includes both short- and long-term trends expected to affect railways, and the identification of key factors that will contribute to railway system's successful development.

Researchers also developed requirements and properties for the four Shift2Rail System Platform Demonstrators (SPDs): freight rail and high-speed/mainline, regional and urban/sub-urban passenger rail systems. Building these indicators will allow assessing socio-economic developments for each system.

2. To measure how each TD contributes to Shift2Rail's targets, partners are **developing a method based on Key Performance Indicators (KPIs) and an integrated assessment** system.

The model identifies three KPI models: capacity, punctuality and life-cycle costs. The next steps will include integrating the three models considering their interdependencies.

3. As part of a global evaluation of **safety** partners reviewed current methods and tools for assessing risk in rail and developed a set of safety indicators, to be used when assessing new Shift2Rail technologies.

4. Shift2Rail is conceiving the best way to translate research results into **standards** and regulatory documents. To ensure this, S2R is developing pre-standardisation processes with relevant bodies as well as with the European Union Agency for Railways under the umbrella of the European Commission.

As part of these standardisation efforts, Shift2Rail is setting up a roadmap, stating the potential needs and opportunities for establishing technical norms. To get a broader overview, partners produced a benchmark study comparing research initiatives in other technical domains.

5. Work on **smart maintenance** already started in 2017 and studies on **smart materials** and **virtual certification** are due to start in the upcoming years.

To improve **smart planning** on activities such as schedules or staff availability, researchers laid the foundations for an enhanced integrated micro-level railway simulation system able to take into account eventual disturbances in the operation. Similar efforts for smart freight traffic management started.

6. Models for improving **energy** efficiency are currently also being developed. Researchers are developing a standardised methodology for estimating the energy consumption and standardised specification of energy-efficient railway systems.

In 2017, Shift2Rail energy experts defined which technologies developed within the Programme are relevant for improving energy efficiency and defined energy indicators to be considered in Shift2Rail technologies. As a point of reference, experts developed an extensive energy baseline, assuring it is representative for state-of-the-art European railway rolling stock.

Researchers have also developed a simulation tool and associated methodology for the assessment of energy implications when introducing upgraded parts in rolling stock.

7. To quantify reductions in **noise and vibration** brought by Shift2Rail new technologies, experts developed a 3D simulator for interior and exterior noise. The tool allows testing new solutions for noise mitigation, based on a thorough assessment of a number of internal and external disturbance sources.

Partners also identified currently available technologies to help reduce noise and vibration and reviewed the interior noise prediction methods used in railway and other industrial sectors.

PROJECTS 2017

IP1: PASSENGER TRAINS

Project Title		Period	Project Value
PIVOT	Performance Improvement for Vehicles on Track	01/10/2017 30/09/2019	€ 18 901 890
Mat4Rail	Innovative materials & modular design for rolling stock applications	01/10/2017 30/09/2019	€ 3 500 000
RUN2Rail	Tools, methodologies and technological development of the next generation of Running Gear	01/09/2017 31/01/2020	€ 2 732 463.75

IP2: TRAFFIC MANAGEMENT

Project Title		Period	Project Value
X2RAIL-2	Enhancing railway signalling systems based on train satellite positioning, on-board safe train integrity, formal methods approach and standard interfaces, enhancing Traffic Management System functions	01/09/2017 31/08/2020	€ 30 152 828,03
ETALON	Energy harvesting methodologies for trackside and on-board signalling and communication devices. Adaptation of already existing technologies for developing a purely on-board Train Integrity	01/10/2017 31/01/2020	€ 1 699 998,75
ASTRail	Operational conditions of the signalling and automation systems; signalling system hazard analysis and GNSS SIS characterization along with Formal Method application in railway field	01/09/2017 31/08/2019	€ 1 797 307,50

IP3: OPTIMISED INFRASTRUCTURE

Project Title		Period	Project Value
IN2STEMPO	Innovative Solutions in Future Stations, Energy Metering and Power Supply	01/09/2017 31/08/2022	€ 13 440 000
MOMIT	Smart metering and asset management of railway systems	01/09/2017 31/08/2019	€ 599 172,50
IN2DREAMS	Switch and Crossing Optional Design and Evaluation	01/09/2017 31/08/2019	€ 2 195 715
FAIR Stations	Future stations and accessibility (IP1 and IP3)	01/09/2017 31/08/2020	€ 1 199 875

IP4: DIGITAL SERVICES

Project Title		Period	Project Value
COHESIVE	Coherent set up and demonstration of integrated travel service	01/09/2017 30/06/2022	€ 4 039 419,45
CONNECTIVE	Connecting and Analysing the Digital Transport Ecosystem	01/09/2017 30/06/2022	€ 7 906 243
My-TRAC	Smart technologies for improved travel companion and trip tracking	01/09/2017 31/08/2020	€ 3 494 476.25

IP5: RAIL FREIGHT

Project Title		Period	Project Value
FR8HUB	Real-time information applications and energy efficient solutions for rail freight	01/09/2017 31/08/2020	€ 9 900 990
OPTIYARD	Optimised Real-time Yard and Network Management	01/10/2017 30/09/2019	€ 1 499 900

CCA

Project Title		Period	Project Value
IMPACT-2	Indicator Monitoring for a new railway Paradigm in seamlessly integrated Cross modal Transport chains – Phase 2	01/09/2017 31/08/2022	€ 7 102 821
SMaRTE	Smart Maintenance and the Rail Traveller Experience	01/09/2017 31/08/2019	€ 769 958,75

2017 ANNUAL ACCOUNTS

BALANCE SHEET

EUR'000

	Note	31.12.2017
NON-CURRENT ASSETS		
Property, plant and equipment	2.1	264
Pre-financing	2.2	34.064
		30.328
CURRENT ASSETS		
Pre-financing	2.2	36.502
Exchange receivables and non-exchange recoverables	2.3	9.647
		46.149
TOTAL ASSETS		**76.477**
CURRENT LIABILITIES		
Payables and other liabilities	2.4	(36.770)
Accrued charges and deferred income	2.5	(28.770)
		(65.541)
TOTAL LIABILITIES		**(65.541)**
NET ASSETS		
NET ASSETS		
Contribution from Members	2.6	89.241
Accumulated deficit		(11.925)
Economic result of the year		(66.381)
NET ASSETS		**10.936**

STATEMENT OF FINANCIAL PERFORMANCE

EUR'000

	Note	2017
REVENUE		-
Revenue from non-exchange transactions		-
Other	3.1	-
Total revenue		
EXPENSES		
Operationg costs	3.2	(63.366)
Staff costs	3.3	(1.364)
Other expenses	3.4	(1.651)
Total expenses		**(66.381)**
ECONOMIC RESULT OF THE YEAR		(66.381)

SHIFT2RAIL IN IMAGES 2017

Digital Transport Days, Tallinn, November 2017

Shift2Rail took part in the **Digital Transport Days in Tallinn**, Estonia, on November 2017, with the objective to explore the potential and to **address challenges of digitalisation of transport and mobility** both for passengers and freight. S2R Executive Director Carlo M. Borghini had the opportunity to exchange ideas with Commissioner for Transport and Mobility Violeta Bulc.

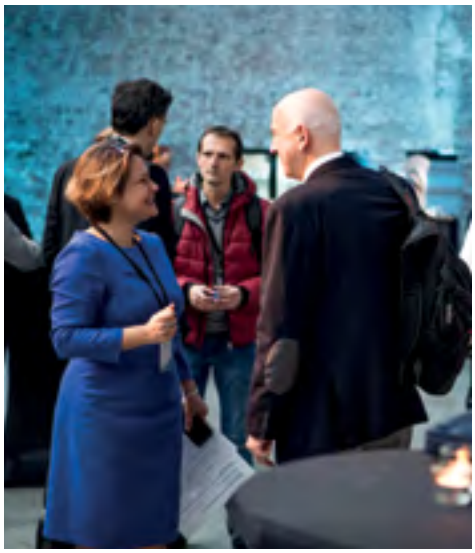
Joint JUs event at the European Parliament in Strasbourg, October 2017

Commissioner Carlos Moedas visited the S2R JU stand at a joint JUs event at the European Parliament in Strasbourg and exchanged his views with the S2R Executive Director in October 2017.

SHIFT2RAIL IN IMAGES 2017

Info Day, Brussels, December 2017

More than 250 professionals gathered at the the **Shift2Rail Info Day event** on December 2017. Members of the Shift2Rail staff presented the details on the Call for Proposals 2018.



S2R PARTICIPANTS MAP

Delivering
together railway
Research & Innovation

SCAN **ME**

In accordance with Article 20 of the Statutes of the S2R JU annexed to Council Regulation (EU) No 642/2014 and with Article 20 of the Financial Rules of the S2R JU. The annual activity report will be made publicly available after its approval by the Governing Board.

WWW.SHIFT2RAIL.ORG

Shift2Rail_JU

Shift2Rail Joint Undertaking

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Horizon 2020
European Union Funding
for Research & Innovation