
Shift2Rail

Innovation Programme 3:

COST EFFICIENT - HIGH CAPACITY INFRASTRUCTURE

Shift2Rail - Entreprise commune européenne
Appels à propositions 2018

Immeuble LUMIERE - 40 avenue des Terroirs de France - 75012 PARIS
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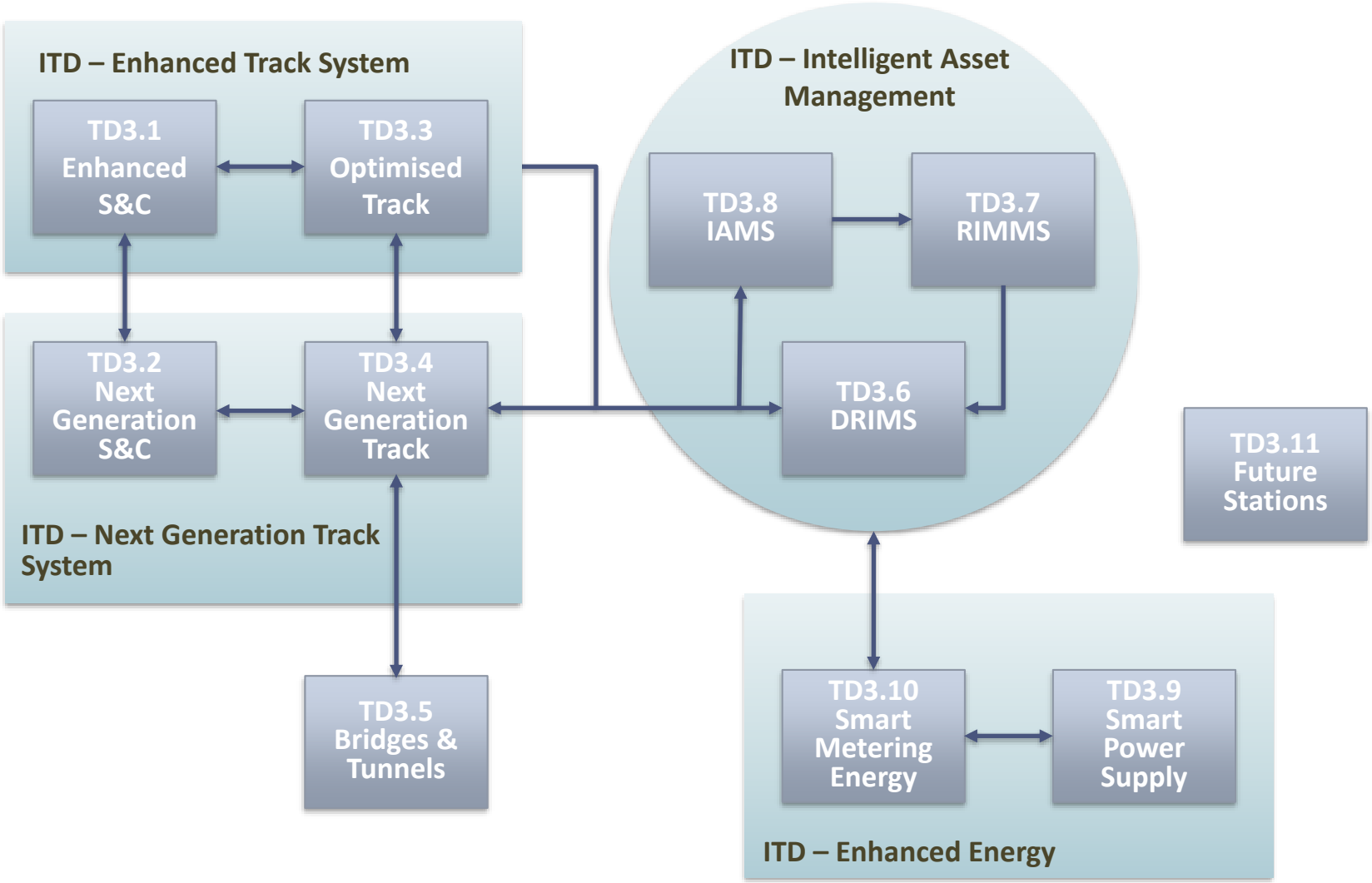
Objectives

High level objectives for the activities within IP3

- New Switches & Crossing, that reduce the 30% of all infrastructure failures on European Railway to 10%
- New track system i.e Ballast/Substructure/Rail, to reduce carbon demand by 50%, reduce whole life cost by 30%, maintain passenger safety and improve safety of track/maintenance workers.
- Intelligent maintenance , fully integrated with the traffic management; embedded monitoring, self adjusting, self repairing, able to predict against traffic demand and usage.
- Enable further savings in infrastructure Managers budgets by 30%

Technical demonstrators



TD3.5 - Proactive Bridge and Tunnel

Assessment, Repair and Upgrade Demonstrator

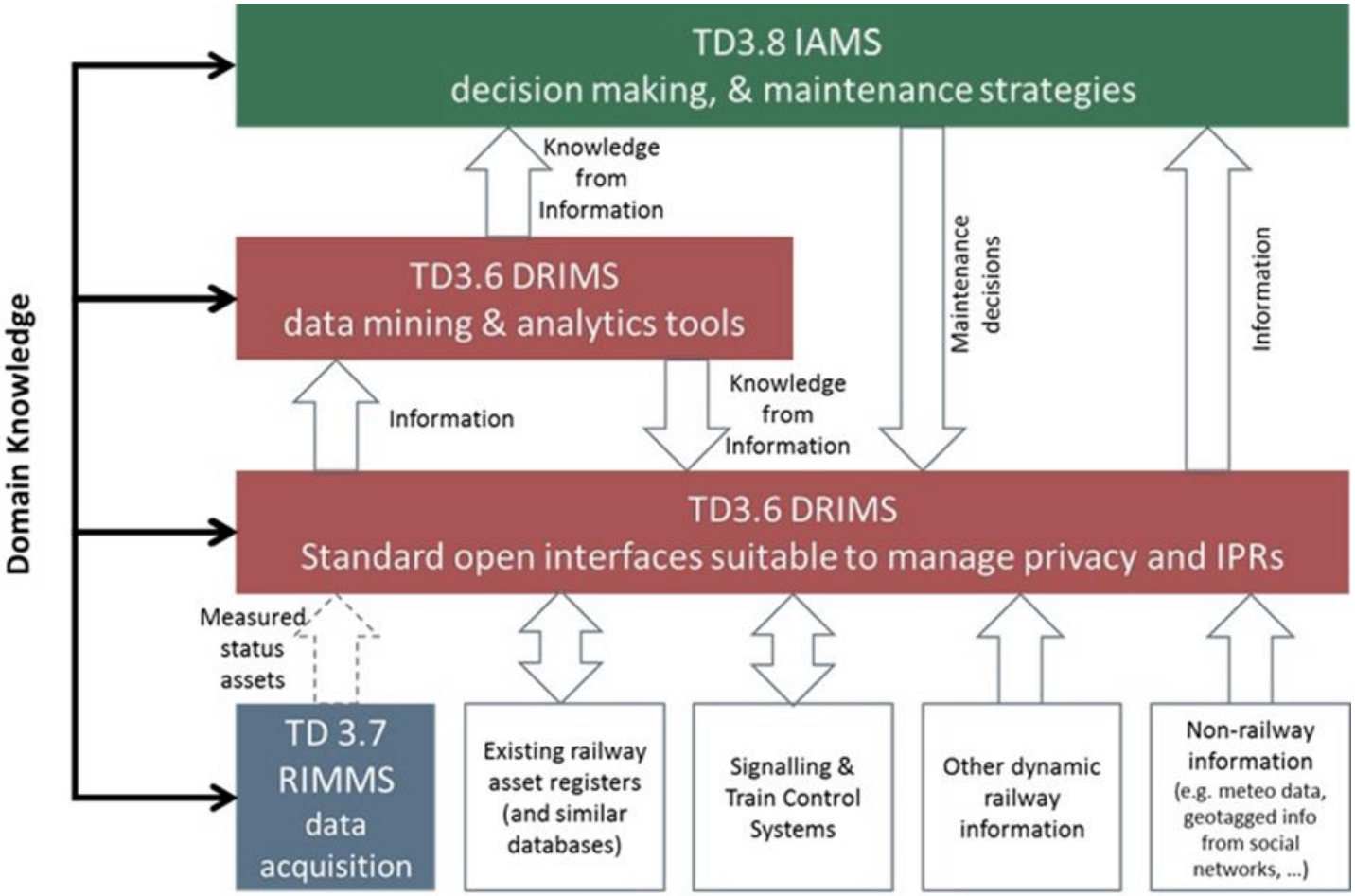
Objectives	Results	Deliverables
Enhanced tunnel and bridge technology for Design, Construction and Maintenance	Justified demands and requirements for tunnel and bridge design, construction and maintenance	Suggestions for codes and standards together with case studies including use of new technologies
Spread knowledge how new and enhanced technology for bridge and tunnels should be used.	Acceptance for new technology	Case studies with application of new technologies and guidelines how it can be used.
Reduce noise and vibration intensity related to structures	Methods for noise and vibration reduction on structures	Guidelines for design of noise and vibration reduction system for bridges and tunnels

TD3.6, TD3.7, TD3.8

Smart and Intelligent Infrastructure Maintenance

New solutions for Rail Asset Registers, Cutting edge measuring and monitoring tools, use based maintenance instead of condition based (maintenance engineering) and maintainability by design will further contribute to minimize cost, increase capacity and reduce noise.

TD3.6, TD3.7 and TD3.8



2018 Annual Work Plan (AWP)
Topics for JU members & non members

For the IP3

Undergoing projects

Topic number	Project acronym	Title	Coordinator
S2R-CFM-IP3-01-2016	IN2TRACK	Research into enhanced tracks, switches and structures	TRV
S2R-OC-IP3-01-2016	S-CODE	Switch and Crossing Optimal Design and Evaluation	THE UNIVERSITY OF BIRMINGHAM
S2R-CFM-IP3-02-2016	IN2SMART	Intelligent Innovative Smart Maintenance of Assets by integRated Technologies	ANSALDO

Topics for JU members

For the IP3

S2R-CFM-IP3-01-2018 -
Research into optimized and future railway infrastructure

Specific Challenge:

In the coming years, we can expect a strong growth in rail transport demand, accompanied by aging infrastructure and growing effects of climate change.

With respect to the rail infrastructure, in order to face these demands, this call consists of research work aiming at enhancing, optimising and developing switches & crossings (linked to TD 3.1 Enhanced switch & crossing system demonstrator and to TD3.2 Next generation switch & crossing system of the S2R MAAP) as well as track systems (linked to TD 3.3 Optimised track system and TD3.4 Next generation track system of the S2R MAAP) including drainage management, in order to ensure optimal line usage and capacity.
The call also includes research on extending the life of bridges and tunnel assets (directly linked to TD 3.5 Proactive bridge and tunnel assessment, repair and upgrade demonstrator of the S2R MAAP) through better approaches for assessing, maintaining, repairing and upgrading these structures. The focus should be on proactive maintenance and operation of all these assets, considering the needs and costs across their whole life including disruption of service.

S2R-CFM-IP3-01-2018 -
Research into optimized and future railway infrastructure

Scope:

In order to address the challenges described above, the proposals should address all the following work streams, in line with the S2R MAAP:

- **Further improve, develop and implement the whole system modelling approaches for track & S&C,** to gain an understanding of how alternative asset designs, materials, etc. affect the overall performance of the railway system.
- **The whole system modelling approach will be validated by simulations**, which will enable faster implementation of new technologies by reducing timely and expensive physical testing. A hybrid testing approach will be taken, meaning that state-of-the-art simulation tools, laboratory and field tests will work collectively to provide a whole system assessment (up to TRL 6).
- **In this context the action will make use of developments from earlier S2R IP3 complimentary projects** in order to deliver the required tools for the track and S&C demonstrator implementation based on the design for reliability concept. These will use the following principles: Performance, Reliability, Availability and Maintainability and change managed through the Common Safety Method approach.

S2R-CFM-IP3-01-2018 -
Research into optimized and future railway infrastructure

- **Continue development of Track and S&C Technology Demonstrators** (up to TRL 6) to meet functional requirements and establish efficient maintenance procedures. **This includes modular track and S&C systems, non-ballasted Track Support solutions** (i.e. slab and Asphalt Track), **control of track stiffness variations in transition zones, advanced welding and repair technologies** (e.g. induction welding) and the **innovative use of materials and advanced manufacturing techniques** (e.g. new rail material, additive manufacturing of crossings and other S&C components.) New rail concepts will also be considered, in addition to improving the performance of the current design. These concepts should reduce the environmental footprint such as noise and vibration from traffic as well as other pollution from the life cycle of the railway system;
- **Develop proof of concept (TRL3) for a bespoke, localised automatic tamping operation (road-rail type vehicle)** to enable localised repair of track geometry deterioration, going beyond the current state-of-the-art techniques, which include the use of large tamping machines that result in the disturbance of 'good' ballast during the treatment of localised track faults;

S2R-CFM-IP3-01-2018 -
Research into optimized and future railway infrastructure

- **Develop proof of concept for ability to monitor European-wide track stiffness in a more efficient way & establish thresholds for maintenance alerts & interventions**. This will then be considered alongside the measuring and monitoring techniques developed in the wider S2R IP3 programme (TRL 3). Current state-of-the-art monitoring techniques can only be deployed on a site by site basis therefore a means of monitoring infrastructure is required to enable predictive and preventative maintenance in Europe, taking into account the relative outcome of the project SMARTE (GA H2020-777627). This will also enable track renewals to be optimised through site prioritisation based upon degradation rates and associated risk;
- **Service life extension of bridges and tunnels** by a combination of deterioration monitoring, proactive maintenance and upgrading technologies for enhanced performance (up to TRL 6). This includes technology for assessing fatigue consumption, methods to increase bearing and fatigue capacity, ways of mitigation of clogged tunnel drainage pipes, technologies for enhanced optical methods for tunnel inspection, and development of partly autonomous monitoring networks with on-site processing capabilities;

S2R-CFM-IP3-01-2018 -
Research into optimized and future railway infrastructure

- **Continue developing requirements for railway bridges for high speed lines.** This includes enhanced understanding of dynamic effects based on tests or simulations in a relevant environment, for example, on a bridge not intentionally built for high speed traffic (up to TRL 5). This will include development of proposals for a modernised design approach including design limits for bridges and the interface with rolling stock, and enhanced knowledge to improve the potential of virtual testing and the tools for compatibility checks between the existing infrastructure and the rolling stock. It is expected that the results will pave the way for the closure of the related open points in the INF TSI. This particular workstream entails collaboration with the European Union Agency for Railways;
- **Develop detailed specification including cost benefit and root cause analysis of the importance of effective drainage management within the track system**; the impact on track geometry; and methodologies to identify drainage assets across the infrastructure (up to TRL 2). This will assess the true cost of ineffective water management across the industry;
- **Develop process for identifying all drainage assets (buried assets)**; carry out horizon scanning for inspection techniques deployed in other industries for buried assets, to support development of a specification for pro-active inspection of the drainage system. This will involve data gathering, data analysis; and a specification for identification of drainage assets and pro-active inspection techniques for the rail industry to support effective water management (up TRL 3).

S2R-CFM-IP3-01-2018 -
Research into optimized and future railway infrastructure

This action will build upon the successes and available results of existing and finalised projects, such as In2Track (GA H2020-730841) and S-Code (GA H2020-730849.) This action will take validated and available past projects outputs through to an early system prototype stage. This will run in parallel to incorporating further innovations and technology developments i.e. drainage management. **A physical prototype of an enhanced S&C solution will be evaluated and installed for preparation of the final Technology Demonstrator.** As part of the installation preparations, safety validation of the final system will be undertaken using the Common Safety Method – Risk Assessment (CSM-RA) process. European railway sites and test facilities will be assessed for hosting the final Integrated Technology Demonstrators (ITD) within future S2R activities.

S2R-CFM-IP3-01-2018 -
Research into optimized and future railway infrastructure

Expected impact:

The action will result in specifications, the start of Common Safety Method Risk Assessment activities to support deployment of the demonstrators, and production of performance indicators to assess demonstrator performance. The innovative technology developed will enable a change in building and operating railway infrastructure compared to present practised methods. With successful prototypes, capacity and reliability should increase together with reduction of costs for railway transports. Substantial contribution is expected in the following areas:

- Development of a framework for virtual assessment and approval with enhanced prediction capabilities;
- Improved LCC, RAMS and environmental aspects through enhanced design of track and S&C components;
- Design of next generation track and S&C components in order to enhance LCC, RAMS and environmental aspects;
- LCC and RAMS improvements through assessment and management of track and S&C status focusing on key parameters and relevant limits on operational conditions;
- Improved RAMS through monitoring solutions to obtain reliable and objective measures of the asset status;

S2R-CFM-IP3-01-2018 -
Research into optimized and future railway infrastructure

- Improved RAMS and LCC through advanced maintenance and repair technologies;
- Reduced LCC through service life extension technologies including upgrading solutions for bridges and tunnels;
- Reduced delay costs from ineffective water management (flooding); reduced costs associated with track geometry faults; improved resilience to climate change; improved attractiveness of railway;
- Reduced costs for railway bridges on high speed lines.

Specific metrics and methods to measure and achieve impacts should be included in the proposals, with the objective to achieve by the end of the S2R Programme the quantitative and qualitative targets defined in the S2R MAAP related to TD3.1 to TD3.5 in line with the relative Planning and Budget.

The research and innovation activities results shall be brought in the form of a demonstrator and prototype(s) as mentioned here above in the context of InnoTrans 2020, including on the S2R JU stand, to show the impacts intended to be achieved.

Topics for non-JU members “Open Calls”

For the IP3

S2R-OC-IP3-01-2018 -
Measuring and monitoring devices for railway assets

Specific Challenge:

One of the objectives of the S2R Master Plan Innovation Programme 3 (IP3) “Cost efficient and reliable infrastructure” is to enable the development of a set of cutting-edge on-board and wayside asset-specific measuring and monitoring devices. These will collect and deliver the status data of the railway system (infrastructure and rolling stock). The information collected by such devices will be then processed to generate relevant maintenance infrastructure-related information to support asset management decisions.

The main challenge of this call is :

- **to identify specific monitoring and upgrading solutions addressed to bridges and tunnels (TD 3.5) and**
- **to develop monitoring solutions for trains and track geometry monitoring as well as data collection from fail-safe systems (TD3.7)**

S2R-OC-IP3-01-2018 -
Measuring and monitoring devices for railway assets

Scope:

I. Research on monitoring of bridges and tunnels including upgrading solutions, to support the aims of TD 3.5:

The activities in this workstream are expected to focus on the following areas:

- **Railway tunnel examination** technologies for subsurface defect detection;
- **Non-traffic disturbing methods for cleaning** long tunnel drainage pipes. This is specifically to remove precipitate calcium products;
- **Development of contactless measurement technology** to detect and monitor noise emissions from train passage over bridges as well as the development of noise dampers for significant noise reduction;
- **Bridge and tunnel information modelling systems** able to import digital data in various formats (such as numerical data, 3-d models and photos) as well as capable of interpreting and filtering data and reporting current asset status compared to previous condition history;
- **Algorithms for bridge information model module**.

S²R cofunding : 2,9 millions €

S2R-OC-IP3-01-2018 -
Measuring and monitoring devices for railway assets

The following main deliverables are expected:

i. Description of novel technology including hardware and software to detect subsurface tunnel defects of significance, validated in a relevant environment (TRL5);

ii. Description of a method for cleaning tunnel drainage. This method should be validated in a relevant environment (TRL5) within an existing tunnel without disturbing traffic nor damaging the pipes;

iii. Description of hardware and software for noise monitoring, demonstrated in a relevant environment on existing bridges during train passage (up to TRL6.) Measurements should be possible from a distance approximately within the range of 5m and 30m. Areas with resonance frequencies between 40Hz and 800Hz are of particular interest. In addition, the deliverables should include specifications of noise dampers for further development and a prototype as well as the development of noise dampers, which should be validated in a relevant environment on an existing bridge (TRL5). The noise dampers should reduce peak noise by approximately 5 dB.

iv. Code for bridge and tunnel information modelling system, which should be demonstrated in a relevant environment (up to TRL6) such as sensor data and structural 3D-models with geometries.

v. Bridge information model module with capability of merging traffic management data, on-board monitoring data, structural influence lines and limited structure sensor data, to store fatigue consumption for individual structural components demonstrated on relevant data (up to TRL6.)

S2R-OC-IP3-01-2018 -
Measuring and monitoring devices for railway assets

II. Research on railway measuring and monitoring systems, to support the aims of TD 3.7 (S2R cofounding : 1,85 millions €):

The activities in this workstream are expected to focus on the following areas:

- **Train monitoring solutions**: in this context the research activities will focus on:
  - Development of "stereo images" systems for measurements of defects on rolling stock;
  - Development of on-track image-based systems for underframe measurements;
  - Automatic features measurement configuration tools and processes;
  - Read/write RFID tags: study, design and development of possible different solutions based on "Read/write RFID tags" for passenger and freight trains;
  - Definition of precise models that quantify the impact of a given measured defect on the infrastructure.
- **Development of a system/sensor to measure the transversal position of the wheel in relation to the rail**: system to be installed on in-service trains fulfilling the following requirements:
  - Reliable measurements for vehicle speeds between 60 and 200 km/h;
  - Insensitive to dust, rain, snow and waste along the track;
  - Installable on different railway bogies taking into account the railway loading gauge;
  - low power consumption.

S2R-OC-IP3-01-2018 -
Measuring and monitoring devices for railway assets

- **Collection of data from fail-safe systems**: Study and development of new diagnostic data collection solutions (HD and SW) designed to achieve seamless safety approval prior to implementation in the field e.g.:
  - signalling systems or train diagnostic collection not interfering with brakes or steering system in the train (no interference with safety systems);
  - a serial connector with a special cable cut for transmission (i.e. only possible to listen to data).

The following main deliverables are expected:

a) Specification of requirements for the collection of data for train monitoring solutions, track geometry monitoring and data collection from fail-safe systems
b) Proof of concept for train monitoring solutions, track geometry monitoring and data collection from fail-safe systems
c) Validation/demonstration of the above mentioned concepts in relevant environment (TRL5/6)

An indicative scheduling of the deliverables is suggested below :

- Deliverables under point a are expected by month 6
- Deliverables under point b are expected by month 18
- Deliverables under point c are expected by month 24

S2R-OC-IP3-01-2018 -
Measuring and monitoring devices for railway assets

Links with other projects:

The action that is expected to be funded under this topic will be complementary to the actions that are expected to be funded under the following topics:

- S2R-CFM-IP3-01-2018: Research into optimised and future railway infrastructure

The action that is expected to be funded under this topic will be complementary to the actions that are funded under the topics:

- S2R-CFM-IP3-01-2016: Research into enhanced track and switch and crossing system
- S2R-CFM-IP3-02-2016: Intelligent maintenance systems and strategies

S2R-OC-IP3-01-2018 -
Measuring and monitoring devices for railway assets

Expected impact:

The technologies to be under this action are expected to have a significant impact on the S2R objectives concerning costs, reliability and capacity. In particular:

Workstream 1:

a) Enhanced inspection and monitoring of bridges and tunnels facilitating proactive maintenance, which will contribute to increased capacity and reliability and reduced costs;
b) Prolonged technical and economical use of structures, leading to less total disturbance, reduced costs and reduced environmental impact;
c) Reduction of noise and vibration levels;
d) Improved capacity by reducing or eliminating existing restrictions in bridge and tunnel monitoring/maintenance.

S2R-OC-IP3-01-2018 -
Measuring and monitoring devices for railway assets

Workstream 2:

a) Train monitoring solutions: increase train monitoring to achieve a better evaluation of their performance and their impact on the infrastructure;
b) Monitoring systems to support track geometry measurements: increase the precision of track geometry monitoring to provide reliable measurements of transversal position of the wheel in relation to the rail;
c) Collection of data from signalling systems: increase the status monitoring of signalling systems by making their diagnostic data available to data analysts to perform specific data analysis.

Specific metrics and methods to measure and achieve impacts should be included in the proposals, with the objective to achieve by the end of the S2R Programme the quantitative and qualitative targets defined in the S2R MAAP related to TD3.5 and TD3.7 in line with the relative Planning and Budget.

Shift2Rail Joint Undertaking
White Atrium building, 2nd Floor
Avenue de la Toison d'Or 56-60,
B-1060 Brussels

www.shift2rail.org