- S2R-CFM IP3-01-2020: Research into optimised and future railway infrastructure

The action stemming from this topic will also be complementary to actions carried out within the following projects:

- IN2TRACK-2 (GA 826255)

IMPACT

The output of this project will contribute towards achieving the S2R MAAP objectives, in the following areas:

- reduction in service affecting delays due to fewer track geometry defects and associated rail failures;
- reduction in noise and vibration at the transition locations, due to provision of a sustained, smooth transfer between areas of differing support stiffness;
- lower lifecycle cost due to a reduction in maintenance and extended operational life of the track and associated assets.

The above will be demonstrated by the cost / benefit analyses carried out for the different operational environments considered.

Type of Action: Research and Innovation Action (RIA)

4.2.7 S2R-OC-IP3-02-2020: Technology Development for Railway Systems Asset Management (TD3.6)

SPECIFIC CHALLENGE

Railway infrastructure maintenance has a key role in annual operational costs. Current technologies provide predictive decay of railway assets used for operational activities planning. The usage of new technologies concerning prescriptive analysis to suggest actions through a decision support system, can contribute to reduce life cycle costs. The challenge is to use prescriptive analytics to provide not only a prediction of future issues but also to provide solutions for preventing and solving them. The objective is to move forward the research activities currently under development in IN2SMART (CFM) and in IN2DREAMS WS2 (OC) S2R JU projects, in order to develop an Intelligent Asset Management System (IAMS) in the railways context.

SCOPE:

Proposals should complementing the DRIMS development, and activities within the S2R JU programme, especially within the S2R-CFM-IP3-01-2020. These activities are described globally in the S2R MAAP –TD3.6 and the S2R-CFM-IP3-01-2020 topic description.

The expected goal concerning the **"**Dynamic Railway Information Management System (DRIMS)" (TD3.6) is to provide technology validation of:

- Prescriptive data analytics[56] tools to implement a Decision Support System (DSS), with man in the loop, for IAMS. The tools should be able to prescribe maintenance actions using data from heterogeneous sources, covering multiple aspects of the railway world. Prescriptive analytics will use a combination of techniques ranging from basic statistics up to machine learning and artificial intelligence (e.g. learning from efficient human behaviours) technologies.

- Multi-objective decisions' optimization tools for IAMS integrating data-driven models into the DSS based on a combination of techniques ranging from mathematical computational model up to artificial intelligence optimization. The tools should be able to dynamically assess multiple risks (e.g. network/operations unavailability, maintenance extra costs, contractual penalties, etc.) of prescriptions managing data and decision uncertainty.

In order to exploit both prescriptive analytics and optimization tools results and to provide them to operators, TD3.6 has to provide also technology validation of:

- Sensitivity analysis methodologies to be applied to both prescriptive analytics and optimization tools (see above bullets), supporting the maximization of consistency and quality of decision-making.

- Context based dynamic human machine interface supporting the DSS operators to manage prescriptive analytics and optimization tools.

All the above shall be developed starting from the results of IN2SMART (D2.2, D8.5, D9.1) and IN2DREAMS WS2 (D5.1, D5.3) S2R JU projects[57].

Proposals should:

- Include at least a railway use case with a sufficiently complete dataset to allow prescriptive analytics.
- Allow the validation of results on another use case provided by the S2R-CFM-IP3-01-2019[58].
- Consider the application of multi-modal transport solution for mitigating the impact of maintenance decisions and infrastructure possession planning.

This work is expected to deliver a TRL 4/5 prototype contributing to the ITDs that will be developed in the S2R-CFM-IP3-01-2019 project.

An indicative scheduling of the deliverables is suggested below[59]:

M10: General requirements; preliminary results related to railway proprietary use case;

M14: Preliminary results related to TDs S2R JU community use case.

[56] Prescriptive Analytics is a form of advanced analytics which examines data or content to answer the question "What should be done?" or "What can we do to make it happen?" https://www.gartner.com/it-glossary/prescriptive-analytics/

[57] Accessible here: https://projects.shift2rail.org/s2r_ip.aspx?ip=3

58 Accessible here: https://projects.shift2rail.org/s2r_ip.aspx?ip=3

[59] The scheduling of the deliverables is provided to facilitate the complementarity with the CFM actions and it is not binding. Additionally, each deliverable may have some flexibility in the scheduling

The S2R Joint Undertaking considers that proposals with a duration of 30 months would allow this topic to be addressed appropriately. Nevertheless this does not preclude submission and selection of proposals with another duration.

COMPLEMENTARITY

As specified in section 2.3.1 of AWP 2020, in order to facilitate the contribution to the achievement of the S2R JU objectives, the options regarding 'complementary grants' of the S2R JU Model Grant Agreement and the provisions therein, including with regard to additional access rights to background and results for the purposes of the complementary grant(s), will be enabled in the corresponding S2R JU Grant Agreements.

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 IP3-01-2019: Intelligent asset management finalisation

EXPECTED IMPACT

Actions will contribute to achieve an increase of the attractiveness and competitiveness of the railway transport in Europe through an efficient, safe, intelligent infrastructure maintenance approach. Expected impacts in detail are:

- Balanced, controlled, cost and risk-effective interventions in between railway services and maintenance.
- Increase operational reliability by 30% through less service disruption, improving users railway attractiveness.
- Optimize maintenance execution by 30% through the multi-objective decisions' optimization tools.
- Life cycle costs reduction by 20%.

Type of Action: Research and Innovation Action (RIA)

4.2.8 S2R-OC-IP3-03-2020: Advanced tools and equipment: collaborative robots & wearable mobile machines (TD3.8)

SPECIFIC CHALLENGE

As described in the MAAP, for TD 3.8 one of the focal areas is new and advanced working methods, tools and equipment and logistics solutions, supporting the LEAN execution of intelligent maintenance processes. For this topic two work streams are defined with each a specific challenge:

- Work stream 1: the challenge is to move forward the research on robotics and make robotic principles rapidly applicable for the rail sector using existing plant (machines and equipment) as a starting point. Currently the primary method of plant control are human operators. This creates a significant risk of incidents caused by human error. There is a great reliance upon compliance and individual competence, which is not always robust. Giving existing plant a