4.2.6 S2R-0C-IP3-01-2020: Next Generation Track Transition Zones

SPECIFIC CHALLENGE

The forecast demand for increased capacity throughout the European rail network over the next few decades, together with the need for improved reliability and punctuality, requires an innovative approach to track design, installation, maintenance and operation. The current, first project within TD3.4 'IN2TRACK2: Next Generation Track' (GA 826255) explores potential technologies, together with innovative condition monitoring and maintenance processes to provide a step change in reliability, availability and performance of plain line track, targeting a time horizon of around forty years beyond current state-of-the-art. The primary objective is to achieve this improvement without being restricted to current practices, whilst retaining key railway functionality. As such, all present perceptions regarding design, maintenance, operations, etc. are being revisited with a much more open frame of mind.

It is recognised that a key factor in enabling the required step change in performance of the track asset is provision of optimum track support conditions within transition zones. These include locations of abrupt changes of track support, typically where plain line track abuts the following features:

- switch and crossing units;
- underbridges or other structures;
- change of track construction (e.g. ballasted to direct fastened track).

The specific challenge is to ensure that the transition zones associated with next generation track solutions provide a sustained, smooth transfer between areas of differing support stiffness. Track stiffness is a key factor affecting operational performance and asset life. If the track support is too soft or variable over a short distance, excessive deformation and deterioration of track geometry may result. However, an overly high support stiffness may cause damage to components, such as rails and fastenings.

Within transition zones, an abrupt change of track support stiffness can lead to significant differential settlement. For ballasted track, this will often result in voiding beneath the sleepers and poor track quality, which in turn increases the dynamic load. This can lead to further settlement, noise and vibration and localised loss of support to the rail, potentially resulting in rail failure, if not adequately addressed.

Transition zones can be difficult and costly to maintain. Transitions from ballasted track onto structures can present a particular challenge. To manage the track geometry, manual lifting and packing is often required, as it is not always feasible to use standard maintenance machines due to the proximity of the bridge deck, especially with direct fastened track. To meet the objectives of TD3.4, next generation transitions should provide optimum and sustained track support conditions, with minimal requirement for maintenance intervention, to prevent the potential for service affecting delays.

SCOPE:

Proposals should complementing the next-generation track system development activities within the S2R JU programme, especially within the action stemming from the S2R-CFM-IP3-01-2020 topic. These activities are described globally in the S2R MAAP –TD3.4 and the S2R-CFM-IP3-01-2020 topic description.

In order to address the challenges described above, proposals should address all the following work streams, in line with the S2R MAAP and with the public deliverables from the project "IN2TRACK" (GA 730841):

- D2.1 'Identifying and Understanding Core S&C Issues'
- D2.2 'Enhanced S&C Whole System Analysis, Design and Virtual Validation'
- D2.3 'Enhanced monitoring, operation, control and maintenance of S&C'
- D3.1 'Enhanced track structure – Status, key influencing parameters and prioritised areas of improvement'
- D3.2 'Enhanced track design solutions through predictive analyses'
- D3.3 'Enhanced inspection, maintenance and operation of track'
- D4.2 'Improvement of tunnels and bridges'

and from "S-CODE" (GA 730849):

- D1.1 'Review of definitions, standard operating parameters, best practice and requirements, including future technologies and horizon scanning'
- D2.1 'High level architecture design document'
- D4.1 'Novel materials and additive manufacturing processes, including opportunities to improve logistics and installation'
- D4.2 'Integration and optimisation of switch and substructure technologies'

Proposals should form the first stage in development of a full-scale next generation transition zone demonstrator, as part of a whole system solution to provide a step change in asset performance and lifecycle cost. Proposals answering this topic should deliver the following:

- protypes and small-scale demonstrators of next generation transition zone components and sub-systems to TRL 5, to validate the next generation transition zone design and simulation;
- Detailed design and technical specification for physical transition zone demonstrators - to be implmented by the S2R-CFM-IP3-01-2020, compatible with relevant outputs of other IP3 CFM projects;
- installation, maintenance and decommissioning requirements to support whole life costing, to quantify business benefits;
- specifications for component and system design and testing criteria, to allow industry implementation of feasible solutions.

The proposed research and development shall address the following tasks, in line with the S2R JU MAAP:

- development of next generation track transition zone solutions, taking account of the following:
  - optimised whole system stiffness, in the frame of the technical complementarity with the research and development on enhanced and next generation track technologies carried out in IN2TRACK-2 (GA 826255);
  - development of integrated/embedded condition monitoring solutions, as part of the transition zone design;
  - design and materials to provide sustainable, whole system solutions to minimise maintenance interventions, noise and vibration, environmental impact and carbon footprint whilst ensuring system resilience against climate change;
  - development of optimum maintenance regimes, to minimise disruption to the operational railway;
  - system boundaries to extend from the natural sub-soil (i.e. beneath the sub-grade and track formation layers) to the wheel-rail interface.

- development to apply a CSM-RA for Hazard Identification (HAZID) and mitigation for all stages of the asset lifecycle, including but not limited to:
    - utilisation of novel materials;
    - optimised design for reliability;
    - manufacturing techniques;
    - installation methodologies;
    - maintenance requirements; and
    - decommissioning
- development of LCC and RAMS performance models, including a full cost/benefit analysis, with due consideration to all anticipated operational and environmental conditions.
- Design and specification for monitoring equipment required to validate the transition zone demonstrator within the S2R-CFM-IP3-01-2020 project.
- Support for integration of the transition zone design into the whole-system next generation track technical demonstrator developed within IN2TRACK-2 and S2R-CFM-IP3-01-2020. This call shall demonstrate compatibility with the technology demonstrators developed within these projects.
- Development of simulation models to support validation of the final transition zone designs for a range of applications, to include the transition between next generation plain line track and:
    - existing track construction types;
    - switch and crossing units;
    - underbridges;
    - other structures, tunnels, etc.

The next generation track transition zone demonstrators should reach TRL 5

An indicative scheduling of the deliverables is suggested below[55]:

- Technical specification for transition zone: M9
- Detailed design: M12
- Simulation model: M14
- Technical specification for monitoring: M16

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:

[55] 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

- 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: