

## **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)

### Scope:

In order to address the challenges described above, the proposed research should address all the following work-streams described below, in line with the Shift2Rail Multi-Annual Action Plan (MAAP):

1. 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.

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.)

An indicative scheduling of the deliverables is suggested below<sup>40</sup> :

- Deliverables under points (i), (ii) and (iii) are expected by month 24.
- Deliverables under points (iv) and (v) are expected by month 30.

The above work stream 1 activities are expected to request a contribution of indicatively € 2.9 million in order to perform technology validation in the corresponding to TRLs, as mentioned above.

## 2. Research on railway measuring and monitoring systems, to support the aims of TD 3.7:

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:
  - o Development of “stereo images” systems for measurements of defects on rolling stock;
  - o Development of on-track image-based systems for underframe measurements;
  - o Automatic features measurement configuration tools and processes;
  - o Read/write RFID tags: study, design and development of possible different solutions based on “Read/write RFID tags” for passenger and freight trains;
  - o 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:
  - o Reliable measurements for vehicle speeds between 60 and 200 km/h;
  - o Insensitive to dust, rain, snow and waste along the track;
  - o Installable on different railway bogies taking into account the railway loading gauge;
  - o low power consumption.
- 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.:
  - o signalling systems or train diagnostic collection not interfering with brakes or steering system in the train (no interference with safety systems);
  - o 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

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<sup>40</sup> 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

- 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<sup>41</sup> :

- 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

The above work stream 2 activities are expected to request a contribution of indicatively € 1.85 million in order to perform technology validation in the corresponding to TRLs, as mentioned above.

The proposed research activity will generate data/information to feed both the TD3.6 “Dynamic Railway Information Management System (DRIMS)” and TD3.8 “Intelligent Asset Management Strategies Demonstrator (IAMS)” models/algorithms to support maintenance and asset management processes.

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

As specified in section 2.3.1 of S2R AWP for 2018, in order to facilitate the contribution to the achievement of S2R objectives, the options regarding 'complementary grants' of the S2R 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 Grant Agreements.

#### 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;

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- 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.

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.

**Type of Action:** Innovation Action.