Shift2Rail
Joint Undertaking
(S2R JU)

ANNUAL WORK PLAN 2016

Version n°2

Annex to GB Decision N° 3/2016

Adopted by the S2R JU Governing Board on 29 February 2016

Shift2Rail Joint Undertaking - Annual Work Plan 2016		
Version N°	***Issue date***	***Change***
1	*11 December 2015*	*Adoption of AWP 2016 by the S2R JU Governing Board*
2	*29 February 2016*	*Amendment: Clarification of eligibility conditions to participate in S2R JU calls for proposals, regarding JU members in the form of a consortium or grouping on pp. 7, 18, 20, 21, 28.* *Addition of Annex IV listing all JU members (founding and associated), other than the Union.*

1 Table of Contents

2 Introduction

2.1 Shift2Rail Joint Undertaking - background information

The Shift2Rail Joint Undertaking (S2R JU) was established by Council Regulation (EU) No 642/2014 of 16 June 2014 (S2R Regulation) until 31 December 2024. The S2R Regulation is accompanied by the S2R Statutes, in its Annex I.

S2R JU is a new public-private partnership in the rail sector established under Article 187 of the Treaty on the Functioning of the European Union, providing a platform for the rail sector as a whole to work together with a view to driving innovation in the years to come. The S2R JU fulfils the criteria for public-private partnerships (PPP) listed in Regulation (EU) No 1291/2013 of the European Parliament and of the Council of 11 December 2013 establishing Horizon 2020[1] ("Horizon 2020 Regulation") and Council Decision (EU) No 2013/743/EU of 3 December 2013 establishing the specific programme implementing Horizon 2020 (2014-2020)[2]. Rail research conducted within S2R JU must contribute to addressing the challenges faced by the rail sector, through a comprehensive and coordinated approach to research and innovation focusing on the needs of the rail system and of its users.

The S2R JU has nine founding members: the European Union, represented by the European Commission, and eight members from the rail industry, consisting of rail equipment manufacturers Alstom, Ansaldo STS, Bombardier, Construcciones y Auxiliar de Ferrocarriles (CAF), Siemens AG, Thales and infrastructure managers Trafikverket and Network Rail. Besides the founding members, S2R JU will also have associated members.

In accordance with S2R Regulation, and Article 4 of S2R Statutes in particular [3], the Commission launched a call for expression of interest to become associated member of the S2R JU, on 6 October 2014[4].

The call document (Ref. S2R JU/AM/01/2014[5]) listed the conditions and procedures for applications, as well as a detailed list of selection and evaluation criteria.

The first stage of the selection procedure for associated members was finalised on 31 March 2015 with a decision of the S2R JU Governing Board approving the results of the evaluation conducted by independent experts, as well as a decision approving the guidelines and template for the second stage submissions. The second stage of the call was launched on 7 April with a deadline of 21 May 2015.

[1] OJ L 347, 20.12.2013, p. 104
[2] OJ L 347, 20.12.2013, p. 965.
[3] OJ L 177, 17.6.2014, p. 9.
[4] Commission Decision N° C(2014) 7084 final
[5] http://ec.europa.eu/transport/modes/rail/news/doc/2014-10-06-shift-to-rail-call/2014-10-06-call-associated-member-s2rju.pdf

The evaluation of the second stage applications was conducted by independent experts. Each time, the experts first assessed and scored the applications individually (between 22 May and 20 June 2015), before coming together within their respective panels to form a consensus score and a consensus report. The consensus week took place from 29 June to 3 July 2015.

The candidates who were positively evaluated and met the required financial thresholds were invited by the Decision of the S2R JU Governing Board to further consultations and negotiations. It is expected that the process of selection of associated members will be concluded in Q4 2015. Then, each member will be expected to sign its individual membership agreement with the S2R JU, defining its legal, operational and financial commitment to the JU.

The completion of membership of the S2R JU constitutes a crucial milestone that must be achieved in order for the JU to launch its first calls for proposals for members and the first open calls for proposals/tenders for non-JU members.

According to Article 19 of the S2R Regulation, the Commission shall be responsible for the establishment and initial operation of the S2R Joint Undertaking until it has the operational capacity to implement its own budget. It is foreseen that the S2R JU will achieve this operational autonomy by Q2 2016.

2.2 Shift2Rail's mission and objectives

The objective of the S2R JU is to implement an ambitious programme of research and innovation activities in the railway sector in Europe. Those activities should be carried out through collaboration between stakeholders in the entire railway value chain, also outside the traditional rail sector, including SMEs, research and technology centres and universities.

The rail research performed within the S2R JU will prioritise the following overall objectives for the duration of the S2R JU, in line with the S2R Regulation and S2R Master Plan:

- Achieve the Single European Railway Area through the removal of remaining technical obstacles holding back the rail sector in terms of interoperability and through the transition to a more integrated, efficient and safe EU railway market, guaranteeing the proper interconnection of technical solutions.
- Radically enhance the attractiveness and competitiveness of the European railway system to ensure a modal shift towards rail through a faster and less costly transition to a more attractive, user-friendly (including for persons with reduced mobility), efficient, reliable, and sustainable European rail system.
- Help the European rail industry to retain and consolidate its leadership on the global market for rail products and services by ensuring that Research & Innovation activities and results can provide a competitive advantage to EU industries and by stimulating and accelerating the market uptake of innovative technologies.

The objectives of the S2R JU should be achieved by means of supporting research and innovation activities by using resources from the public and private sectors. To this end, the S2R JU will organise calls for proposals for supporting research, demonstration and deployment activities.

As specified in Article 17 of the S2R Statutes, up to 70% of the S2R JU budget will be implemented directly by the members of S2R JU (founding and associated members) and their affiliated entities following calls for proposals that are accessible to members only. At least 30% of the S2R budget will be implemented through open, competitive calls accessible only to entities that are not members of the S2R JU (founding or associated), nor constituent entities of members in the form of consortia or groupings, nor affiliated entities either to the S2R JU members or to the constituent entities of members in the form of consortia or groupings.

In accordance with Articles 1(4) and 2(a) of S2R Statues, the Governing Board of the S2R JU adopted, on 31 March 2015, a strategic Master Plan[6], which identifies the key priorities of S2R R&I and indicates the main operational and technological innovations that are required to achieve the objectives of the JU. The S2R Master Plan is a living document that may be updated by the Governing Board of the S2R JU, in accordance with the procedure set out in the S2R Regulation.

2.3 Shift2Rail's Annual Work Plan

This document establishes the Annual Work Plan (AWP) of the S2R JU for 2016.

The Annual Work Plan 2016 is based on the draft Annual Work Plan 2016 adopted[7] in accordance with Article 19 of the S2R Statutes, which foresees that the Executive Director must draw up and submit for adoption to the Governing Board a draft annual work plan, on the basis of the S2R Master Plan. The draft Annual Work Plan included a detailed plan of the research and innovation activities, the administrative activities and the corresponding expenditure estimates for the coming year, as well as the estimated value of the in-kind contributions to be made by members other than the Union and their affiliated entities in implementing indirect actions, in accordance with point (b) of Article 16(3) of the Statutes. The Annual Work Plan 2016 follows the adoption of the Financing Decision of the S2R JU by the European Commission.[8]

The AWP of the S2R JU indicates IPs and research and innovation areas foreseen in the Master Plan in which the work would be led in priority within a given year, and a plan for

[6] This S2R Master Plan was developed by the Commission services in close cooperation with the 8 Shift2Rail founding members other than the Union and incorporates comments received from stakeholders during numerous individual meetings with sector representatives and a public consultation meeting held on 20 June 2014, to which close to 200 stakeholders took part. The document was first approved by the Governing Board of the S2R JU on 24 September and consequently endorsed by the Council on 10 February and is available at: http://ec.europa.eu/transport/modes/rail/shift2rail_en.htm

[7] Decision n°13/2015 of the S2R Governing Board.

[8] The Commission Decision on the Union financial contribution to the Shift2Rail Joint Undertaking for 2016 (C(2015) 7780 final) was adopted on 13 November 2015.

their effective and efficient implementation. In order to ensure that the AWP for any given year is anchored in a long-term approach that guarantees the continuity and synchronicity of all S2R JU R&I activities, in accordance with Article 2(c) of the S2R Regulation, the S2R JU Governing Board will also develop a long-term investment plan, the S2R 'Multiannual action plan' (hereinafter "MAAP").

The MAAP will identify the concrete actions, milestones and deliverables to be undertaken and produced during the lifetime of the S2R JU and it will provide a framework for the long-term cooperation between all members of the S2R JU and the other participants in S2R JU actions.

It is on the basis of this MAAP that the S2R JU members' long-term individual contributions to the JU will be defined in their membership agreements.

2.4 Shift2Rail's research and innovation priorities

The S2R Master Plan identifies the key strategic priorities of S2R initiative, looking at a 2030 horizon, encompassing therefore research activities beyond the programmatic period of S2R JU. It proposes a holistic approach of the rail system that takes into consideration all the relevant railway subsystems and actors, as well as their complex interaction.

Given this whole-system approach, the S2R Master Plan is structured around five Innovation Programmes (IPs) and five cross-cutting themes and activities (CCA):

1. **Innovation Programme 1 (IP1): Cost-efficient and reliable trains**

   The design of rolling stock plays a key role for the attractiveness of rail transport. Only trains that are comfortable, reliable, affordable and accessible can convince passengers to use rail transport instead of other modes. At the same time, the train design has to meet the requirements of the railway undertakings and the urban operators, who are the main customers of the rail supply industry, in order to deliver high quality and cost-efficient services to their customers.

   If rail is to compete more effectively with other modes and attract more passengers in the future, it needs a future generation of passenger trains that will be lighter, more energy and cost-efficient while at the same time providing a comfortable, safe and affordable travel experience for all passengers.

   The S2R Master Plan identifies seven priority research and innovation areas in which activities should be undertaken with a view to achieving the ambition of IP1:

   - Traction
   - Train Control and Monitoring System
   - Carbodyshell
   - Running Gear
   - Brakes
   - Doors and Intelligent access systems
   - Train interiors

2. Innovation Programme 2: Advanced traffic management and control systems

Control, command and communication systems should go beyond being only a contributor to the control and safe separation of trains and become a flexible, real-time, intelligent traffic management system.

Although ERTMS has become a worldwide dominant solution for railway signalling and control systems, it has the potential to offer increased functionalities and become even more competitive. Current systems do not sufficiently take advantage of new technologies and practices, including use of satellite positioning technologies, high-speed, high-capacity data and voice communications systems (Wi-Fi, 4G/LTE), automation, as well as innovative real-time data collection, processing and communication systems, which have the potential to considerably enhance traffic management (including predictive and adaptive operational control of train movements), thereby delivering improved capacity, decrease traction energy consumption and carbon emissions, reduce operational costs, enhance safety and security, and provide better customer information.

The S2R Master Plan identifies seven priority research and innovation areas in which activities should be undertaken with a view to achieving the ambition of IP2:

- Smart, fail-safe communications and positioning systems
- Traffic Management Evolution
- Automation
- Moving block (MB) and train integrity
- Smart procurement and testing
- Virtual coupling
- Cyber security

3. Innovation Programme 3: Cost Efficient and Reliable High Capacity Infrastructure

The design, construction, operation and maintenance of rail network infrastructure have to be safe, reliable, supportive of customer needs, cost-effective and sustainable. In order to deliver the benefits of market opening and interoperability and to reduce the life cycle costs of rolling stock and on-board signalling systems, the network diversity needs to be eliminated, notably through a migration towards a common high-performing infrastructure system architecture.

Activities that can support the reduction of infrastructure maintenance costs, such as simplified procedures or automation, need to be led in priority. They should propose solutions that can be rapidly and efficiently deployed. Furthermore, the infrastructures have to be managed in a more holistic and intelligent way, using lean operational practices and smart technologies that can ultimately contribute to improving the reliability and responsiveness of customer service, as well as the capacity and the whole economics of rail transportation.

In order to be competitive with other modes but also integrated with them, compatibility between different modal infrastructures (including multimodal hubs, changing points and stations) needs to be ensured and based on principles of interoperability and standardisation.

The S2R Master Plan identifies six priority research and innovation areas in which activities should be undertaken with a view to achieving the ambition of IP3:

- New directions in switches and crossings
- Innovative track design and materials
- Cost effective Tunnel & Bridge solutions
- Intelligent system maintenance
- Energy efficiency
- Improved station concepts

4. Innovation Programme 4: IT Solutions for attractive railway services

In order to become more attractive, rail must respond to customer needs to support seamless door-to-door intermodal journeys encompassing different modes of transportation. Rail must achieve interoperability with other transport modes and mobility services, within different regions, cities and across borders. In order to achieve this, rail needs to take due advantage of the ever growing connectivity of people and objects, the availability of European GNSS based location, the advances in cloud computing, big, linked and open data and the propagation of Internet and social media. The step towards sharing data needs to be considered and progressively developed, using open standards and specifications, in order to enable service developers to provide the connected travellers with the services they need and expect.

To achieve a full seamless multimodal travel experience, the customers must be able to easily plan and purchase door-to-door journeys. Ticketless or multi-application solutions that guarantee interconnectivity no matter where the traveller roams should become the norm. The development of truly multimodal infrastructure, providing for simple and seamless interchanges, including among different transport modes (urban and regional rail, air transport, road transport, cycling and walking) should make transfers easy, comfortable and reliable. For this reason, the timetables should be increasingly integrated across transport modes to allow better modal integration and minimise travellers' inconvenience.

The S2R Master Plan identifies three priority research and innovation areas in which activities should be undertaken with a view to achieving the ambition of IP4:

- Technical framework
- Customer experience applications
- Multimodal travel services

5. Innovation Programme 5: Technologies for sustainable and attractive European rail freight

The cost competitiveness and the reliability of freight services need to be considerably improved if the rail sector is to meet the ambitious objectives that were set in the Transport White Paper in terms of developing rail freight[9]; almost doubling the use of rail freight compared to 2005, achieving a shift of 30% of road freight over 300 km to modes such as rail or waterborne transport by 2030, and more than 50% by 2050. Rail freight must be in a position to offer a cost-effective, attractive service to shippers that helps to take freight away from the already-congested road network.

Different market segments with specific technical and operational characteristics and needs can be identified. The first segment is the intermodal segment, which mainly relies on the use of containers / trailer trains and where continued growth can be expected. Reliability, service characteristics and cost competitiveness in this segment can progress significantly with an increase in train length, better length utilisation, innovative rolling stock features for value-added services, progress in the terminal operations, improved real-time customer information to customers and better data exchange between involved parties in the intermodal transport chain. A second market segment is the wagon load / block train activity segment, which relies on the use of specific freight wagons. This segment has significantly declined in the past years and its significant growth potential can only be fully exploited if a step change is made in terms of service quality and reliability. Solutions such as automated coupling and decoupling, tagging of all wagons with RFID tags automatically readable provide a huge potential to speed up and reduce costs in train formation and to improve the overall performance of wagonload services.

The S2R Master Plan identifies eight priority research and innovation areas in which activities should be undertaken with a view to achieving the ambition of IP5:

- Implementation Strategies and Business Analytics
- Freight Electrification, Brake and Telematics
- Access and Operation
- Wagon design
- Novel Terminal, Hubs, Marshalling yards, Sidings
- New Freight Propulsion Concepts
- Sustainable rail transport of dangerous goods
- Long-term vision for an autonomous rail freight system

[9] WHITE PAPER Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system /* COM/2011/0144 final, Goal N°3.

6. Cross-cutting themes and activities

In addition to the five Innovation Programmes, the work of S2R JU R&I activities will include cross-cutting activities (CCA) relevant to each of the different sub-systems and taking into account the interactions between these sub-systems.

These cross-cutting activities will ensure that the R&I activities within the different Innovation Programmes are closely aligned in terms of their objectives and their requirements, as well as the methodologies for evaluation and assessment of impacts. These activities include elements already taken into account in the different Innovation Programmes that require horizontal coordination (such as energy and noise management) and additional research that will be necessary to complement the technical work of S2R.

The S2R Master Plan identifies five priority research and innovation areas in which activities should be undertaken with a view to achieving the objectives of the CCA:

- Long-term needs and socio-economic research
- Smart materials and processes
- System integration, safety and interoperability
- Energy and sustainability
- Human capital

3 Governance

The S2R JU is composed of two Executive bodies: the Governing Board and the Executive Director. In addition, there are two advisory bodies: the Scientific Committee and the States Representatives Group.

3.1 Governing Board

The Governing Board has overall responsibility for the strategic orientation and the operations of the S2R JU and supervises the implementation of its activities, in accordance with Article 8 of the S2R JU Statutes[10].

The Governing Board of the JU was established after the 8 Founding Members of the S2R JU other than the Union listed in Annex II to the S2R Regulation endorsed the S2R Statutes and once all founding members, including the Union, nominated their representatives and alternate representatives to the Board.

In accordance with the S2R Regulation, the JU Governing Board is currently composed of two representatives from the Commission and one representative from each of the founding members of the S2R JU other than the Union. Once the procedure for selecting associated members is completed, the number of representatives in the Governing Board will be extended to include representatives from the associated members, in accordance with Art. 6 of the S2R Statutes.

In line with the provisions of the S2R Statutes, a representative of the European Railway Agency and the chairperson or the vice-chairperson of the States Representatives Group will have the right to attend meetings of the Governing Board as observers and take part in its deliberations, but with no voting rights. The chairperson of the Scientific Committee will be invited to attend meetings of the Governing Board as an observer and take part in its deliberations, whenever issues falling within its tasks are discussed, but has no voting rights.

In 2016, the Governing Board is planning to hold three ordinary meetings.

The key activities are listed below:

Key activities in 2016 – timetable	
Adopt 2015 Annual Activity Report	Q1
Adopt Conflict of Interest Procedures and Policy	Q1
Be consulted on the communication strategy	Q2
Adopt Internal Control Standards and Internal Control Framework	Q2
Adopt a manual of Financial procedures	Q2
Adopt the practical arrangements for implementing “Regulation (EU,	Q2

[10] Annex to the Council Regulation (EU) No 642/2014 of 16 June 2014 establishing the Shift2Rail Joint Undertaking ("S2R Regulation").

Euratom) No 883/2013 of the European Parliament and of the Council of 11 September 2013 concerning investigations conducted by the European Anti-Fraud Office (OLAF) and repealing Regulation (EC) No 1073/1999 of the European Parliament and of the Council and Council Regulation (Euratom) No 1074/1999 (OJ L 248, 18.9.2013, p. 1)."	
Discuss draft 2018 Annual Work Plan	Q4
Adopt the key documents for the S2R JU's operations in 2017: 2017 Annual Work Plan, 2017 budget and staff establishment plan	Q4
Discuss draft budget 2018	Q4

3.2 Executive Director

According to Article 10 of the S2R Statutes, the Executive Director is the chief executive responsible for the day-to-day management of the S2R JU in accordance with the decisions of the Governing Board. The Executive Director is the legal representative of the S2R JU. The Executive Director is accountable to the Governing Board. He is supported by the JU staff.

In accordance with Article 19 of the S2R Regulation, the Commission is responsible for the establishment and initial operations of the S2R JU until it has the operational capacity to implement its own budget. The Commission will carry out, in accordance with Union law, all necessary actions with the involvement of the competent bodies.

The European Commission appointed an Interim Executive Director, on 09 July 2014. The Interim Executive Director will fulfil the functions of the Executive Director until he/she takes up his/her duties.

The recruitment process for the position of Executive Director was launched on 25 July 2014 (vacancy notice COM/2014/10363), in line with Article 9 of the S2R JU Statutes. The vacancy notice was published on the website of EPSO and the website run by the S2R promoters. The deadline for applications was 22 September 2014. 44 applications were received. The Commission concluded the selection process without proposing any short list of candidates to the Governing Board. The vacancy notice was consequently republished on 27 May 2015 with the deadline to submit applications of 26 June 2015.

The appointment of an Executive Director is a pre-requisite for the S2R JU to obtain its budgetary and financial autonomy, as, in accordance with Art. 19.4 of S2R Regulation, the JU will reach the capacity to implement its own budget at a date determined by the Interim Executive Director in common accord with the Executive Director, subject to the approval of the Governing Board.

The Executive Director is expected to take office at latest in March 2016. Then, the process for obtaining JU's autonomy is expected to be concluded in Q2 2016.

Selection of Executive Director – key elements	
Re-publication of the Vacancy notice	27 May 2015
Deadline for submission of applications	26 June 2015
Set up of a preselection panel, screening of applications with regard to the selection criteria, and interviews of the short-listed candidates with the European Commission's Consultative Committee on Appointments (CCA)	Q3 2015
Interviews with the Commissioner for Transport and with the S2R JU Governing Board, decision on appointment	Q4 2015
Taking office	March 2016 (at latest)

3.3 Scientific Committee

According to Article 13 of the S2R Statutes, the Scientific Committee is an advisory body to the Governing Board.

The Scientific Committee shall carry out the following tasks:

- advise on the scientific and technological priorities to be addressed in the annual work plans;
- advise on the scientific and technological achievements described in the annual activity report;
- suggest possible areas of advanced research that could be subject to further developments;
- suggest possible synergies with national and international research and innovation activities in the rail technical domain, in particular via the European Rail Research Advisory Council (ERRAC) Technology Platform, as well as with those in other domains, as identified in Article 2(k) of the S2R Statutes.

The S2R JU launched the selection procedure of its Scientific Committee on 21 October 2014 through the publication of an open call for expression of interest.[11] The call document (Ref. S2R JU/SC/01/2014[12]) listed the eligibility conditions, evaluation and selection criteria and procedures for applications. The deadline for applications was 22 December 2014.

The call was published on the website of DG MOVE and the website of the S2R promoters (www.shift2rail.org). In accordance with the S2R Regulation, the call was also advertised through the ERRAC technology platform, the European Railway Agency and the States Representatives Group, who were invited to nominate potential candidates.

[11] http://ec.europa.eu/transport/modes/rail/news/shift-to-rail-call-members-scientific-committee_en.htm

[12] http://ec.europa.eu/transport/modes/rail/news/doc/2014-10-22-shift-to-rail-call/call-members-scientific-committee.pdf

The selection panel completed the evaluation of the applications in February 2015 and the Governing Board decided on 31 March 2015 on the final selection of the successful candidates to appoint in the S2R Scientific Committee as well as on the constitution of a reserve list. The S2R Scientific Committee was established further to this decision and held its first meeting on 28 May 2015. The tentative key activities are listed below:

Key activities in 2016 - timetable	
3rd Meeting of the SC. The SC would: – Provide advice on the draft 2017 Annual Work Plan. – Provide advice on the planned calls for proposals.	Q2
4th Meeting of the SC. The SC would: – Provide advice on the scientific priorities to be addressed in the 2018 Annual Work Plan, including links with similar research activities carried out for example in Horizon 2020 – Provide advice to the GB on the programme progress of the S2R and other strategic issues	Q4

3.4 States Representatives Group

Following the entry into force of the S2R Regulation, Members States and countries associated to the Horizon 2020 framework programme were asked to nominate their representatives to the States Representatives Group, in accordance with Article 14 of the S2R Statutes. To date, the 28 countries have nominated representatives to the Group.

A first meeting of the States Representatives Group was organised on 16 October 2014 in Brussels. During that meeting the States Representatives Group adopted its rules of procedures and proceeded with the election of the Chair and Vice-Chair persons.

The States Representatives Group shall be involved and, in particular, review information and provide opinions on the following matters:

- updating of strategic orientation and of the S2R Master Plan and progress towards achievement of its targets;
- the S2R JU Annual Work Plans;
- links to Horizon 2020 and to other Union and Member State funding instruments, including the Connecting Europe Facility, and the ESIF;
- links to the Union rail transport legislation and the goal of achieving a Single European Railway Area;
- involvement of SMEs and relevant actors from outside the traditional rail sector.

The States Representatives Group also provides information to, and acts as an interface within, the S2R JU on the following matters:

a) the status of relevant national or regional research and innovation programmes and identification of potential areas of cooperation, including deployment of relevant technologies to allow synergies and avoid overlaps;

b) specific measures taken at national or regional level with regard to dissemination events, dedicated technical workshops and communication activities.

The States Representatives Group may issue, on its own initiative, recommendations or proposals to the Governing Board on technical, managerial and financial matters as well as on annual plans, in particular when those matters affect national or regional interests.

During the year 2016, at least two meetings of the States Representatives Group are planned (Q2 and Q4).

The tentative key activities are listed below:

Key activities in 2016 - timetable	
4th Meeting of the SRG. The SRG would: – Provide advice on the draft 2017 Annual Work Plan. – Provide advice on the planned calls for proposals.	Q2
5th Meeting of the SRG. The SRG would: – Provide advice on the scientific priorities to be addressed in the 2018 Annual Work Plan, including links with similar research activities carried out for example in Horizon 2020 – Provide advice to the GB on the programme progress of the S2R JU and other strategic issues – Provide updated information and discuss initiatives on: regional and national research and innovation programmes to allow synergies; dissemination and communication activities; and deployment activities in relation to S2R JU.	Q4

4 Operational activities 2016

As mentioned previously, the activities of the S2R JU will be based on the priorities set out in the S2R Master Plan and further developed in the framework of the Multi-Annual Action Plan.

In accordance with Art. 2 of S2R Statutes, the S2R JU will financially support research and innovation indirect actions, mainly through grants to its members and to participants through the most appropriate measures, such as procurement or the award of grants following calls for proposals to achieve the programme objectives, in accordance with Regulation (EU) No 1290/2013.

Consequently, the S2R activities will be implemented either directly by the members of S2R JU following calls for proposals that are accessible only to JU members (founding and associated), and their affiliated entities[13], pursuant to Article 9.5 of Regulation (EU) No 1290/2013, or through open, competitive calls for proposals accessible only to entities that are not members of the S2R JU (founding or associated), nor constituent entities of members in the form of consortia or groupings, nor affiliated entities either to the S2R JU members or to the constituent entities of members in the form of consortia or groupings.

More details on the planned calls that will be launched in 2016 can be found in section 4.2.

Prior to this, a number of projects were launched by the Commission under the general Horizon 2020 Transport Work Programme for 2014, within the Challenge “Smart, green and integrated transport”, call “Mobility for Growth”, topic 2. Rail. These projects kicked off their activities on 1 May 2015 and are expected to contribute to the achievement of the objectives and goals of the JU. It is also foreseen that the Commission transfers the management of these projects to the JU once it will have reached its operational and financial autonomy. More details on these projects, which will lay the foundations for future work under the S2R JU, can be found in section 4.1.

4.1 On-going activities HORIZON 2020 – WORK PROGRAMME 2014-2015 – 2014 call "Mobility for Growth", and 2015 S2R call

In 2014, there was no call launched specifically by the S2R JU. However, the Work Programme 2014-2015 of Horizon2020, and specifically the Challenge “Smart, green and integrated transport”, call “Mobility for Growth”, topic 2. Rail in 2014, specified that “the selected proposals will contribute to the objectives of the initiative to be implemented under a public-private partnership (Shift2Rail) as they will later be integrated into the activities of this partnership”.[14]

[13] In the case of members in the form of consortia or groupings of legal entities, the individual constituent entities of these consortia or groupings, and their affiliated entities, are eligible to participate in the restricted calls for JU members.

[14] https://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/main/h2020-wp1415-transport_en.pdf, p.22.

7 proposals were retained for funding for a total value of € 67,153,627. 3 of these projects are currently managed by DG MOVE, 1 by DG RTD and 3 by INEA (the Innovation & Networks Executive Agency). The Grant Agreements for all 7 projects were prepared and signed in late April 2015.

In accordance with Article 3.1(b) of the S2R Regulation, it is foreseen that the management of the 4 projects currently managed by DG MOVE and DG RTD (hereinafter the 'lighthouse projects'), for a value of € 51,997,759, may be taken over by the S2R JU once it achieves the operational capacity to implement its own budget (i.e. towards Q2 2016, once the Executive Director has been appointed). These four projects started on 1 May 2015 and will run for 30 months (2 projects) or 36 months (2 projects). The take-over of the management of the projects by the JU would require an amendment of the relevant grant agreements, signed by the European Commission. As the EC Work Programme 2014-2015 does not contain sufficiently detailed requirements, the options on complementary grants in S2R MGA are not mandatory for the beneficiaries of these projects following the take-over, who may accept them on a voluntary basis, subject to their explicit agreement.

The activities within the four aforementioned projects were kicked off on 1 May 2015. The first reporting period of all projects is set for 18 months after the start date of the project, i.e. in November 2016. The second and final reporting period of these projects coincides with their end date, respectively in month 30 (2 projects) and month 36 (2 projects). Assessing the progress achieved within these projects, along with the progress made in other S2R activities, will enable to determine what are the gaps and missing tasks/activities, in order to realise the full potential and objectives of the respective Research and Innovation areas from the five Innovation Programmes defined by the S2R Master Plan. The results of the reporting of the 2014 projects will feed into fine-tuning the calls for proposals to be launched in 2017 and preparing 2018 Annual Work Plan and calls for proposals to be launched that year.

In 2015, the S2R JU is planning to launch one call for proposals addressed to JU members, one open call for proposals addressed to non-JU members and one call for tenders for non-members. The strategic priorities for these calls are linked to activities within IP2, IP4, IP5 and CCA.

As a result of these 2014 and 2015 calls, it is expected that the operational activities will be engaged in all Innovation Programmes, and Cross-Cutting Activities, as described in S2R Master Plan, albeit sometimes to a limited extent.

Further calls for proposals, in the form of open calls for non-JU members or calls for proposals addressed to JU members will aim to ensure that activities financed by the S2R JU cover all research and innovation areas within all Innovation Programmes, and all necessary activities are underway in an adequate manner, in order to successfully converge into integrated Technology Demonstrators and System Platform Demonstrators at the end of the S2R research programme.

4.2 Overview of 2016 planned operational activities

The table below identifies the calls that the S2R JU is planning to launch in 2016, in order to launch its operational activities. The main means of implementation of the activities foreseen in the Annual Work Plan are grants that will be signed following the calls for proposals (relevant information is provided in sections 4.2.1-4.2.5).

Actor	Activity	Type of call	Indicative EU contribution	Indicative minimum in-kind contribution of JU members	Indicative publication date
JU members	Call for Proposals	Closed - Restricted to JU members	€ 29.1 mln	€ 36.4 mln	Q4 2015*
Non-JU members	Call for Proposals	Open	€ 16.1 mln	N/A	Q4 2015*
TOTAL			€ 45.2 mln	€ 36.4 mln	

* In order to ensure a meaningful start of activities in all Innovation Programmes and Research areas of the S2R Master Plan, it is foreseen that in Q4 2015 S2R JU will publish its calls (call for proposals for JU members and open call for proposals for non-JU members) related to 2015 Annual work Plan, and those related to 2016 Annual Work Plan. Following the adoption of the EC Financing Decision for S2R JU for 2016 and of the 2016 Annual Work Plan, it will be possible to pull together the JU's financial contribution for these two years and launch relevant calls for proposals together towards the end of 2015.

4.2.1 S2R JU's calls for proposals – general information

Art. 25 of H2020 Regulation, regarding public-private partnerships states that "public-private partnerships shall make public funds accessible through transparent processes and mainly through competitive calls, governed by rules for participation in compliance with those of Horizon 2020. Exceptions to the use of competitive calls should be duly justified".

In the case of S2R JU, as specified in Article 17 of the S2R Statutes, up to 70% of the Union financial contribution to the S2R JU may be allocated to the members of S2R JU (founding and associated members), and their affiliated entities, following calls for proposals that are accessible to members only. At least 30% of the S2R budget must be implemented through open, competitive calls for proposals or calls for tenders accessible to non-members of the S2R JU. The aforementioned ratio applies to the overall budget implementation for the duration of the S2R JU, and does not necessarily need to be respected on an annual basis.

In light of this, and in order to fulfil the aforementioned allocation of the Union financial contribution, the JU will distinguish between:

- calls for proposals, which, pursuant to art. 9.5 of Regulation 1290/2013 and art. 17.1(a) and (b) of S2R JU Statutes, will restrict the type of beneficiary to JU members (founding and associated), and their affiliated entities. In the case of members in the form of consortia or groupings of legal entities, the individual constituent entities of

these consortia or groupings, and their affiliated entities, are eligible to participate in the restricted calls for JU members;

- and open, competitive calls for proposals (or tenders) that, pursuant to art. 9.5 of Regulation 1290/2013, will be addressed only to entities that are not members of the S2R JU (founding or associated), nor constituent entities of members in the form of consortia or groupings, nor affiliated entities either to the S2R JU members or to the constituent entities of members in the form of consortia or groupings.

The JU plans to launch its 2016 call for proposals for JU members, in Q4 2015, following the signature of the membership agreements with founding and associated members.

The JU plans to launch its 2016 open call for proposals addressed to non-JU members in Q4 2015.

More details of the management process of the calls for proposals are presented in section 4.2.5 below.

4.2.2 S2R JU's calls 2016 – strategic priorities

One of the major objectives of the S2R programme is to achieve the development of Integrated Technology Demonstrators in different rail segments (urban, regional, main line, freight) that will demonstrate the benefits of the technologies developed within specific technology demonstrators, at the system level. For this reason, the technological development in all Innovation Programmes should be led in synergy, so that all physical developments converge in time into the final demonstration activity.

The projects resulting from H2020 2014 MG.2 call and from 2015 calls for proposals cover a number of initial tasks in all Innovation Programmes. In order to ensure that all the pre-requisites are in place for a timely and successful completion of integrated Technology Demonstrators and System Platform Demonstrations, further activities have to be foreseen in IP1, IP3 and IP4 in 2016.

Consequently, the calls for proposals launched under 2016 Annual Work Plan will cover further, complementary to on-going, activities in research and innovation areas in IP1, IP3 and IP4, with an appropriate intensity. It is foreseen that this call for proposals will mostly include Research and Innovation actions (RIA), corresponding to lower TRL activities, leading later to development of Innovation Actions (IA), corresponding to higher TRL levels.

4.2.2.1 *Innovation Programme 1: Cost-efficient and reliable trains*

Within the scope of IP1 most research areas have started in the lighthouse projects resulting from 2014 H2020 call, but only with a very limited scope. It can be expected that further topics regarding research activities in this IP will be featured in the calls for proposals launched under 2016 Annual Work Plan, both in the call for proposals for S2R JU members and in the open call for non-JU members.

4.2.2.2 *Innovation Programme 3: Cost efficient and Reliable High Capacity Infrastructure*

Within the scope of IP3 most research areas have started in the lighthouse projects resulting from 2014 H2020 call, but only with a limited scope. It can be expected that further topics regarding research activities in this IP will be featured in the calls for proposals launched under 2016 Annual Work Plan, both in the call for proposals for S2R JU members and in the open call for non-JU members.

4.2.2.3 *Innovation Programme 4: IT Solutions for Attractive Railway Services*

Within the scope of IP4 the initial activities within all Research and Innovation areas described in the S2R Master Plan are covered by activities of one of the lighthouse projects. However, the solutions developed will mostly be co-modal in nature, combining different transport modes, but not bringing them into one intermodal chain of travel shopping, booking and integrated ticketing. For this reason, further activities are needed in order to pave the way towards a fully multimodal integration, mainly by completing the work on ontologies and specifications with regards to intermodal solutions. Consequently, launching further activities within IP4 will be among priorities in 2016.

4.2.3 Call for proposals for S2R JU members

This section presents the indicative list of topics that will be included in the call for proposals for JU members, in line with the priorities defined in the previous section.

The S2R JU is planning to issue one call for proposals addressed to JU members related to 2016 strategic priorities, in Q4 2015, as explained above. The budget for this call is estimated at EUR 29.1 million (in EU contribution). The indicative minimum value of the in-kind contributions to be made by members other than the Union and their affiliated entities in implementing indirect actions pursuant to the call for proposals for members is EUR 36 381 548.

Detailed topic descriptions are provided in the Annex I to the Annual Work Plan 2016.

The topics described below are broad in nature, but combine tasks which need to be developed in close cooperation and in the same initial timeframe for achieving the objectives of S2R.

It is foreseen that the call for proposals will be launched in Q4 2015, with activities expected to start in Q4 2016.

Proposals should be invited against the following topics:

Topic number - IP	Topic name	Expected TRL	Type of action	Indicative Union contribution	Indicative minimum in-kind contribution from members other than the Union
S2R-CFM-IP1-01-2016	Development of concepts towards the next generation of traction systems and management of wheel/rail adhesion	2-5	RIA	€ 13 000 000	€ 23 754 275
S2R-CFM-IP1-02-2016	Development of new technological concepts, standard specifications and architectures for train control and monitoring, with specific applications in train-to-ground communications and high safety electronic control of brakes	2-6	RIA	€ 6 000 000	
S2R-CFM-IP3-01-2016	Research into enhanced track and switch and crossing system	1-5	RIA	€ 2 800 000	€12 627 273
S2R-CFM-IP3-02-2016	Intelligent maintenance systems and strategies	1-5	RIA	€ 7 300 000	
TOTAL				€29 100 000	€36 381 548

4.2.4 Open call for proposals for non-JU members

This section presents the indicative list of topics, in line with the priorities defined in section 4.2.2, that will be included in the open call for proposals for non-JU members, addressing the broader research and innovation community.

The S2R JU is planning to issue one open call for proposals addressed to non-JU members related to 2016 strategic priorities, in Q4 2015, as explained above. The budget for this call is estimated at EUR 16.1 million (in EU contribution).

Detailed topic descriptions are provided in the Annex II to the Annual Work Plan 2016.

The topics described below are broad in nature, but combine tasks which need to be developed in close cooperation and in the same initial timeframe for achieving the long-term objectives of S2R.

It is foreseen that the call for proposals will be launched in Q4 2015, with activities expected to start in Q4 2016.

Proposals should be invited against the following topics:

Topic number - IP	Topic name	Expected TRL	Type of action	Indicative Budget (EU contribution)
S2R-OC-IP1-01-2016	Tools and methodologies supporting the development of next generation traction systems, and brakes	2-3	RIA	€ 1 100 000
S2R-OC-IP1-02-2016	Technology feasibility studies supporting the development of next generation TCMS, and safe control for brakes	2-3	RIA	€7 000 000
S2R-OC-IP3-01-2016	Research into new radical ways of changing trains between tracks	1-4	RIA	€ 5 000 000
S2R-OC-IP4-01-2016	Interoperability Framework governance, ensuring its market uptake and sustainability		CSA	€2 000 000
S2R-OC-IP4-02-2016	Interoperability Framework Converters	2-4	RIA	€ 1 000 000
TOTAL				€ 16 100 000

4.2.5 Management rules for calls for proposals

The S2R JU follows the rules of the European Union's Horizon 2020 framework programme (H2020) and in particular the Horizon 2020 Rules for participation[15]. Unless specified otherwise, the provisions in all sub-sections of the section 4.2.5 apply to both calls for proposals addressed to JU members and open calls for proposals addressed to non-JU members.

4.2.5.1 *Types of calls for proposals*

The calls for proposals that will be launched by the JU may be: calls for proposals restricted to JU members (as explained in section 4.2.1), or open, competitive calls for proposals for non-JU members.

With respect to strategic priorities on 2016 Annual Work Plan, the JU plans to launch one call for proposals addressed to JU members and one open call for proposals addressed to non-JU members, in Q4 2015. The key activities for the management of the foreseen 2016 calls for proposals are presented in the tables below:

2016 Management process for the call for proposals addressed to JU members	**Indicative timing**
Preparation of the call for proposals	Q3-Q4 2015
Publication of the call for proposals	17 December 2015[16]
Deadline for the submission of proposals	17 March 2016
Selection of the experts and evaluation of proposals	Q1-Q2 2016
Preparation and signature of S2R Model Grant Agreement for JU members (**)	Q2-Q3 2016
2016 Management process for the open call for proposals addressed to non-JU members	**Indicative timing**
Preparation of the call for proposals	Q3-Q4 2015
Publication of the call for proposals	17 December 2015[17]
Deadline for the submission of proposals	17 March 2016
Selection of the experts and evaluation of proposals	Q1-Q2 2016
Preparation and signature of S2R Model Grant Agreement for non-JU members (**)	Q2-Q3 2016

** Maximum Time to Grant of 8 months from the deadline for the submission of proposals.

As specified in section 2.4, the Shift2Rail research and innovation programme is organised into five Innovation Programmes (IP1-IP5), together with one area of Cross-Cutting Activities

[15] Regulation (EU) No 1290/2013 of the European Parliament and of the Council of 11 December 2013 laying down the rules for participation and dissemination in "Horizon 2020".
[16] Date subject to the approval of the S2R Governing Board.
[17] Date subject to the approval of the S2R Governing Board.

(CCA). In order to facilitate the contribution of indirect actions towards the achievement of S2R 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.

Specifically, the following grants will be considered complementary in order to allow for the overall achievement of the objectives of the IP in question:

- Certain grants to S2R JU members and non-members supporting actions within each IP, stemming from the 2016 calls for proposals for S2R JU members (S2R-CFM-IPX-XX-2016) and the open calls for proposals (S2R-OC-IPX-XX-2016), which are established by this Annual Work Plan 2016, and
- Certain grants to S2R JU members and non-members supporting actions within each IP and within the area of CCA, stemming from the calls for proposals for S2R JU members (S2R-CFM-IPX/CCA-XX-2015) and the open call for proposals for (S2R-OC-IPX/CCA-XX-2015), which are established by S2R JU Annual Work Plan 2015.

Grants to S2R JU members and non-members supporting actions within the IPs and/or within the area of CCA, which may be established by future S2R JU Work Plans for years 2017 and beyond, may be rendered complementary to the grants identified above insofar as they relate to similar topics and/or rely on some of the results of those grants.

Complementarity between particular topics is specified within their scope, in Annexes I and II to this Annual Work Plan.

A number of results produced within certain grants are expected to contribute to European or international standards; hence the standard wording regarding 'results that could contribute to standards' is included in relevant topic descriptions in Annexes I and II, and the corresponding option will be enabled in the S2R JU Grant Agreements.

Similarly, standard wording obliging beneficiaries to 'disseminate any technical specifications of the results that are needed for interoperability' and to 'disseminate the deliverables relating to cross-border interoperability' are included in relevant topic descriptions in Annexes I and II, and the corresponding options will be enabled in the S2R JU Grant Agreements.

4.2.5.2 *List of countries eligible for funding*

Part A of the General Annexes to the EC Horizon2020 Work programme 2016-2017 applies.[18]

4.2.5.3 *Standard admissibility conditions and related requirements*

Part B of the General Annexes to the EC Horizon2020 Work Programme 2016-2017 applies[19].

[18] http://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2016-2017/annexes/h2020-wp1617-annex-ga_en.pdf

4.2.5.4 *Standard eligibility conditions*

In line with the objective of combining public and private sector funding to ensure the development and implementation of a long-term investment plan for rail research and innovation, Articles 17(1)(a) and (b) of the S2R Statutes foresee that up to 70% of the Union financial contribution to the S2R JU may be allocated to the S2R JU members (up to 40% for Founding Members and up to 30% for Associated Members). At the same time, is in line with Article 2(1)(e) of the S2R Regulation, which states that the S2R JU should pursue the objective of promoting broad stakeholder participation in the activities of the S2R JU, Article 17(1)(c) of the S2R Statutes foresees that at least 30 % of the Union financial contribution to the S2R JU shall be allocated by way of competitive calls for proposals and calls for tenders.

In light of this, and in order to fulfil the aforementioned allocation of the Union financial contribution, the JU will distinguish between:

- calls for proposals, which, pursuant to art. 9.5 of Regulation 1290/2013 and art. 17.1(a) and (b) of S2R JU Statutes, will restrict the type of beneficiary to JU members (founding and associated), and their affiliated entities. In the case of members in the form of consortia or groupings of legal entities, the individual constituent entities of these consortia or groupings, and their affiliated entities, are eligible to participate in the restricted calls for JU members;
- and open, competitive calls for proposals (or tenders) that, pursuant to art. 9.5 of Regulation 1290/2013, will be addressed only to entities that are not members of the S2R JU (founding or associated), nor constituent entities of members in the form of consortia or groupings, nor affiliated entities either to the S2R JU members or to the constituent entities of members in the form of consortia or groupings.

The full list of S2R JU members and, in the case of members in the form of consortia or groupings of legal entities, the individual constituent entities of these members can be found in Annex IV.

Furthermore, Part C of the General Annexes to the EC Horizon2020 Work Programme 2016-2017 applies[20].

Within the call for proposal for JU members, in the case of associated members comprised of several legal entities, such legal entities shall be deemed not independent of each-other in the sense of the eligibility conditions for participation set out in Part C.

4.2.5.5 *Types of action: specific provisions and funding rates*

Part D of the General Annexes to the EC Horizon2020 Work Programme 2016-2017 applies[21].

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[19] http://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2016-2017/annexes/h2020-wp1617-annex-ga_en.pdf

[20] http://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2016-2017/annexes/h2020-wp1617-annex-ga_en.pdf

This means that the funding rate for grants will be 100% of the total eligible costs for research and innovation actions and coordination and support actions, and 70% of the total eligible costs for innovation actions (except for non-profit legal entities where a rate of 100% applies)[22].

4.2.5.6 *Evaluation rules*

Part H of the General Annexes to the EC Horizon2020 Work Programme 2016-2017 applies[23].

Selection criteria include 'financial capacity' and 'operational capacity'. Award criteria include 'excellence', 'impact' and 'quality and efficiency of the implementation'.

For full proposals, each award criterion will be scored out of 5. The threshold for individual criteria will be 3. The overall threshold, applying to the sum of the three individual scores, will be 10. For Innovation actions, to determine the ranking, the score for the criterion 'impact' will be given a weight of 1.5.

Proposals submitted within the call for proposals for members or within the open call for proposals for non-JU members will be evaluated by independent experts, as foreseen by S2R Regulation in its Article 17.2. The evaluation of award criteria will take into account the coherence of the proposal with the Multi-Annual Action Plan.

Details on the submission and evaluation process are described in the Grants Manual - Section on: Proposal submission and evaluation.[24]

4.2.5.7 *Budget flexibility*

Part I of the General Annexes to the EC Horizon2020 Work Programme 2016-2017 applies[25].

4.2.5.8 *Financial support to third parties*

Part K of the General Annexes to the EC Horizon2020 Work Programme 2016-2017 applies for actions performed by non-JU members, supported by the JU[26].

Part K of the General Annexes to the EC Horizon2020 Work Programme 2016-2017 applies for actions performed by JU members, supported by the JU[27].

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[21] http://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2016-2017/annexes/h2020-wp1617-annex-ga_en.pdf

[22] As set out in Art. 28(5) of Regulation (EU) No 1290/2013, the 70% upper limit for innovation actions does not apply to non-profit legal entities.

[23] http://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2016-2017/annexes/h2020-wp1617-annex-ga_en.pdf

[24] http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/pse/h2020-guide-pse_en.pdf

[25] http://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2016-2017/annexes/h2020-wp1617-annex-ga_en.pdf

[26] http://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2016-2017/annexes/h2020-wp1617-annex-ga_en.pdf

[27] http://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2016-2017/annexes/h2020-wp1617-annex-ga_en.pdf

4.2.5.9 *Consortium agreement*

The legal entities wishing to participate in a project shall form a consortium and appoint one of its members to act as its coordinator. They will conclude a Consortium agreement among themselves prior to the signature of the Grant agreement.

4.3 Key Performance Indicators (KPIs)

An indicative list of KPIs has been elaborated by the Commission aiming at the establishment of 3 groups of indicators, namely:

- Horizon 2020 Key Performance Indicators[28] common to all JTI JUs;
- Indicators for monitoring H2020 Cross-Cutting Issues[29] common to all JTI JUs;
- Key Performance Indicators specific for S2R JU.

They can be consulted in the Annex III to this document.

Further S2R specific Key Performance Indicators, together with a proper baseline to assess S2R technology developments, and their methodology, will be developed within the study performed under CCA "Long-term needs and socio-economic studies", starting in early 2016.

[28] Based on Annex II to Council Decision 2013/743/EU.
[29] Based on Annex III to Council Decision 2013/743/EU.

5 Horizontal and support activities

5.1 Communication activities

One of the main objectives of communication activities is to ensure public awareness about the S2R JU's activities, in order to gain acceptance and support from various audiences at European and national level. For that reason, the role of the stakeholders will be essential, especially the State Representatives Group, as an interface towards Member States, national and regional policies and programmes.

It is equally important to promote the programme outputs, its R&D achievements and the culture of innovation that S2R is building within the sector. A major point of attention in communication activities continues to be the need to ensure the involvement of stakeholders from the entire rail value chain, including actors from outside the traditional rail sector.

In June 2015, the S2R JU signed a specific contract, for Communication with RETELL consortium, under the Framework contract № RTD-L05-2010-INFORMATION PRODUCTS LOT 1 of DG RTD. The value of the contract is 98.929,57 over 12 months, and the contractor will provide support to S2R JU in Web and Print Communication. Follow up contracts for Communication services will be tendered out by the S2R JU. The relevant information is provided in Section 5.3.3.

Once S2R JU will reach its autonomy, the dissemination of information on the progress of actions and its results will also be included in the overall communication strategy. This strategy, which will be developed in late 2015/early 2016 will include specific actions in order to ensure outreach to both stakeholders and public.

> *Nota bene: A specific Communications Officer and Stakeholders' Relations Project Officer will be recruited, in order to ensure a successful communication about S2R JU, publicize and disseminate information about its programmes and activities, and foster a strong stakeholders' network.*

Globally, the communication activities will aim to:

- **Raise awareness about the S2R JU** among key stakeholders across Europe from the rail sector and beyond, given the ambition of a better integration of rail with other modes for both passengers and freight managers endeavour.
- **Promote stakeholders' engagement** along and across the value chain in order to facilitate cooperation and knowledge exchange. This objective will require the organisation of fora, conferences on specific topics stemming from the Innovation Programmes.

  Both of the two aforementioned objectives will require close work with different stakeholders and their associations.

- **Promote S2R JU within the EU Institutional arena**. This objective consists of gaining political support for S2R JU from the EU institutions and EU Member States through the promotion of S2R JU, its objectives and achievements. Target audience for this objective includes the European Parliament and/or the Council and policy makers in EU Member States. This objective will require the organisation of events inside the European Parliament, the participation in visibility events such as exhibitions, Open Days, publications/ presentations of key achievements.
- **Establish and develop a network of press and media contacts** in order to achieve considerable visibility in both specialised and general media. This network could be useful for providing visibility to the publication of press releases and specific articles related to S2R JU's activity.
- Pro-actively **publish communication material** in regards to external events and meetings related to S2R JU. A broad dissemination of factsheets, leaflets, brochures etc. will enhance the visibility of S2R JU towards other stakeholders, including the general public.
- **Mobilise applicants for S2R JU Open calls for proposals** across Europe, ensuring a balanced representation of Member States and actors from different stakeholders groups. It will also include organisation of the S2R Research Infodays, in Brussels.
- **Manage the S2R JU website** in order to stimulate the public interaction on key issues and improve public awareness on S2R JU activities.
- **Lead a coherent dissemination strategy** regarding projects' activities and achievements, notably via coordinating web, documents and event management of the projects, and their presence on the S2R website.

Further to the above, S2R will rely on multipliers and ambassadors:

- Scientific Committee;
- Local multipliers in the Member States such as States Representative Group reaching out to local stakeholders;
- S2R Members, in particular S2R project coordinators and participants, who will communicate the success of S2R to various audiences;
- S2R management and staff;
- ERRAC (European Rail Research Advisory Council) reaching out to policy makers and decision makers inside ERRAC.

5.2 Budget and Finance

5.2.1 2016 Annual budget

The draft annual budget for 2016 has been adopted by the Governing board on 16 July 2015.

The Commitment Appropriations (in EUR) in the budget are set to:

	2016
Title 1 - Staff expenditure	1 253 928
Title 2 - Infrastructure and operating expenditure	1 987 446
Title 3 - Operational expenditure	45 248 848
Total	**48 490 222**

The Payment Appropriations (in EUR) in the budget are set to:

	2016
Title 1 - Staff expenditure	1 253 928
Title 2 - Infrastructure and operating expenditure	1 987 446
Title 3 - Operational expenditure	24 888 492
Total	**28 129 866**

The overview of the financial contributions and of estimated value of in-kind contributions from the Members other than the Union is the following:

Contribution overview from members other than the Union	**2015**	**2016**
Title 1 and Title 2 (financial)	1 352 212	1 620 687*
Title 3 (in-kind)		79 639 334**
TOTAL CONTRIBUTIONS	**1 352 212**	**81 260 019**

*A contribution of EUR 268 491 from the industry towards the budget 2014 is foreseen to be collected in 2016. This has not been included in the figures represented here.

**It is foreseen that calls for proposals for members included in 2015 and 2016 Annual Work Plans will be launched at the same time in Q4 2015. The resulting grants will be signed in 2016, thus the indicative minimum in-kind contributions from members to indirect actions are accounted for in 2016 budget (at minimum € 43 257 786 for 2015 and € 36 381 548 for 2016). This estimate is a minimum commitment from the members, and it might be further amended if the call amounts would change.

5.2.2 Financial Management

During 2016, the budget of the S2R JU will be executed by the Interim Executive Director of the S2R JU and the European Commission in accordance with Article 19 of the S2R Regulation. This approach will continue until the JU gains the full autonomy to execute its own budget. Once the Executive Director takes office and the JU reaches its administrative and budgetary autonomy, the budget of the JU will be executed by the Executive Director of the JU.

5.2.3 Staffing

In 2016, the JU foresees to recruit one (1) temporary agent (Head of Administration and Finance) and five (5) Contract Agents.

5.2.4 Learning and professional development

The JU promotes learning and development among its staff also with respect to functions outside their initial job descriptions. This will guarantee the JU more flexibility during the peak periods of work load on task sharing and create back-up functions for the moments of absence. The current organisational chart foresees a single jobholder per function of the JU. This may be seen as a risk in respect of the contingency.

5.3 Other support activities

5.3.1 IT tools

For the calls for proposals resulting from strategic priorities outlined in the 2015 and 2016 Annual Work Plans that will be launched in Q4 2015, it is planned that the Commission H2020 IT systems will be used for the publication of the call, as well as for the submission, and evaluation of the proposals and grant preparation.

A Cooperation tool to facilitate the work on Multi-Annual Action Plan has been set up by the S2R JU Programme Office.

5.3.2 Accounting system – Accounting Officer

The European Commission's Accrual Based Accounting system (ABAC) will be used for accounting purposes. The accounting system will be put in place with the assistance of DG BUDGET. A formal request to DG BUDGET was made in this context. The setting-up of the S2R legal entity in ABAC will be finalized once the procedure of selection of the Executive Director will be completed.

Then, the Governing Board of the S2R JU will be expected to appoint its Accounting Officer.

5.3.3 Procurement and Contracts

In order to reach its objectives and adequately support its operations and infrastructures, S2R JU will allocate funds to procure the necessary services and supplies. In order to make tender and contract management as effective and cost-efficient as possible, S2R JU makes use of the SLA (Service Level Agreements) with relevant Commission services, multi-annual framework contracts available to it and inter-institutional tenders.

In 2014, S2R JU entered into a SLA with PMO (Pay Masters Office of the Commission) to cover the calculation of the entitlements and to assure the insurance coverage of its staff.

In early 2015, the S2R JU also completed SLA agreements with further Commission services to benefit from the already designed mechanisms and tools in its administration:

- SLA with DG HR covering the medical services and training for staff;
- SLA with DG BUDG covering the IT tools used for the financial management of the JU (ABAC).

In addition to these two SLAs, the S2R JU will assess whether any additional services are required by the S2R JU. Based on this assessment, the S2R JU may conclude SLA agreements with EPSO on the recruitments, DGT on the translations of the official documents, DG HR and DG DIGIT for the roll-out of human resources management tool, and OPOCE on the publications. To secure the S2R JUs usage on the H2020 grant management tools, the Delegation Act with REA is foreseen sufficient and no SLA will need to be completed for this purpose.

In addition to the SLAs, in 2015 the S2R JU entered into a contract on housing and various works and services accompanying it. The contract on the housing covers the leasing of office space in White Atrium building, when a number of other Joint Undertakings have their offices. The S2R JU joined the already existing contract with other JUs, covering the full lifespan, until 2024. In connection to this contract, some works were conducted in the premises.

The S2R JU participates to the joint effort with other JUs on the networks, ICT back office and other support functions. To this purpose, S2R JU concluded a number of Memoranda of Understanding (MoUs) with other JUs and contributes to the cost on the basis of consumption or partition key defined. The tendering of these services has been completed by the signing party, other than the S2R JU, in each MoU. Further services and goods, which are not covered by either already existing Framework Contract directly open to S2R JU or via MoUs as detailed above, will be tendered out by the S2R JU. The indicative planning for these tenders for services and goods in 2016 may be consulted below but should not be treated exhaustive.

Indicative Title	**Indicative expenditure (EUR)**	**Type of procedure**	**Indicative schedule**
Team Building Event	<15 000	Negotiated procedure for low-value contracts	1Q2016
Contract on mobile phone subscriptions	45 000	Negotiated procedure for low-value contracts	1Q2016
Health and safety equipment	<15 000	Negotiated procedure for low-value contracts	1Q2016
Organisation of events, stands at conferences & exhibitions	<60,000.00	Negotiated procedure with three tenderers	2Q2016
Publications	Max. 25,000.00	Negotiated procedure for low-value contracts	2Q2016
Publicity materials	< 60,000.00	Negotiated procedure with three tenderers	2Q2016
Web site hosting & maintenance	Max. 25,000.00	Negotiated procedure for low-value contracts	2Q2016
Web site support - helpdesk & analytics	Max. 10,000.00	Negotiated procedure for low-value contracts	2Q2016

Web site - Print Support	< 60,000.00	Negotiated procedure with three tenderers	2Q2016
Web site development - content writing	Max. 10,000.00	Negotiated procedure for low-value contracts	2Q2016
Subscriptions to journals & periodicals	Max. 25,000.00	Negotiated procedure for low-value contracts	2Q2016
Basic office furniture	<15 000	Negotiated procedure for low-value contracts	3Q2016
Dissemination of research results	< 109,000.00	Negotiated procedure	4Q2016
Multiplier events	< 60,000.00	Negotiated procedure with three tenderers	4Q2016

5.4 Annual Activity Report

The Annual Activity Report (AAR) presents the progress made by the S2R JU in each calendar year, in particular in relation to the Annual Work Plan for that year.

It includes information on the performed activities, the costs and the contribution of the S2R JU for any individual project, the participation of SMEs and any other activities during the previous year, with the corresponding expenditure.

2016 AAR will be presented to the Governing Board by the Interim Executive Director, by the end of February 2017. It will be approved in the Governing Board's meeting in Q1 2017 and subsequently made public.

5.5 Management control and internal control procedures

The S2R JU and its bodies shall avoid any conflict of interest in the implementation of the activities.

According to Article 26 of the Financial Rules, the internal audit function shall be performed by the Commission's internal auditor. The internal auditor shall advise the S2R JU on dealing with risks, by issuing independent opinions on the quality of management and control systems and by issuing recommendations for improving the conditions of implementation of operations and promoting sound financial management.

The S2R JU shall protect the financial interests of the members and implement anti-fraud measures. In particular, the S2R JU shall ensure that the financial interests of its members are adequately protected by carrying out or commissioning appropriate internal and external controls.

Furthermore, the Internal Control Standards from the Commission will be adapted for the purpose of the S2R JU and a Manual of Procedures will be drafted.

6 2016 Milestones

In 2016, the S2R JU operations will focus on:

- Grant agreement preparation and signature for projects resulting from the first calls for proposals, that will be launched in Q4 2015;
- Evaluation of offers and signature of specific contracts for studies resulting from the call for tenders, that will be launched in Q4 2015;
- Establishment of the working groups, when appropriate;
- Preparing a 2017 Annual Work Plan and the draft 2018 Annual Work Plan;
- Taking office by the Executive Director;
- Establishing the accounting system, necessary for the JU autonomy;
- Recruiting and training staff members;
- Concluding additional Service Level Agreements with relevant services of EU bodies in relation to administration and procedures that need to be implemented by the JU;
- Concluding the necessary procurement procedures and contracts to support the administration of the JU;
- Putting in place the internal control framework and the staff committee.

ANNEX I

2016 Call for proposals for the JU members – Topic descriptions

S2R-CFM-IP1-01-2016 – Development of concepts towards the next generation of traction systems and management of wheel/rail adhesion

Specific Challenge: There are two main specific challenges concerning traction systems and management of wheel/rail adhesion.

1. *Traction systems*

The Traction Drive sub-system is one of the main sub-systems of a train as it moves the train converting energy from an electrical source (directly or via a chemical source) into a mechanical one.

The physical domains to master are multiple: electrical, mechanical, thermal, and automatic. A large number of norms and regulations have to be taken into account for traction systems design, manufacturing, validation and certification. The challenges, at this point, are:

- to master technologies breakthrough developments like Silicon carbide (SiC) semi-conductors applied to different railways traction applications and wheel independent rotating wheels for HST;
- to develop and contribute to implementing new methodologies, tools, norms & standards of reliability, noise, virtual validation and certification, smart maintenance.

2. *Adhesion*

The wheel-rail contact is normally not only a great source of uncertainty in the prediction of braking distances, but it can constitute a general bottleneck for the achievable braking effort of the train – and to a substantial degree for the tractive effort as well. Due to environmental as well as technical issues the properties of this rail-wheel contact are highly variable. This affects a large number of rail traffic characteristics, like headways, punctuality and especially safety. The challenge is to develop a proper mapping of different adhesion conditions occurring in rail traffic, and the investigation of the effect of methods to modify basic adhesion, in order to achieve optimal traction and braking effort in the future.

Scope*:* Proposals should address all the following elements, in line with the Shift2Rail Multi-Annual Action Plan (MAAP):

1. *Traction systems*

The work regarding traction work should cover:

- the update of relevant specifications on five applications (tramway, metro, sub-urban, regional and high-speed trains (HST)) both for new solutions and refurbishment

markets, including traction spare parts obsolescence management. The update of marketing needs on all five targeted applications (tramway to HST);

- Development of new hardware and software traction components and sub-systems (especially Silicon Carbide based but also independently rotating wheel architecture for HST) customised for different market segments. Develop energy savings solutions (on board energy storage, hybrid traction, energy management, etc…). Develop specific maintenance solutions (Condition Based Monitoring of traction components, remote diagnostic, on-board and/or off-board software, etc.), leading up to the preparation of "smart-maintenance" integrated demonstrator for Shift2Rail. Industrials and Operators should cooperate as much as possible in LCC business model definition and quantification. Identify and mitigate barriers to innovation implementation (norms, cultural habits, etc…). Prepare test bench tests and assess their results.
- Develop methodologies and tools for noise emission prediction and reduction (noise levels and tonal noise, electromagnetic, aerolic and EMI noise) for traction sub-system, components and parts (ex.: fans) in all phases of vehicle use including parking mode.
- Develop methodologies and tools to increase traction system reliability and smart maintenance. Use real operator data and return of experience as much as possible.
- Investigate the development of methodologies for virtual validation and certification of traction systems, as well as tools for Traction KPIs and Traction local performance indicators quantification by simulation of energy consumption.
- Perform pre-standardisations tasks for new solutions & new technologies (e.g. new insulation material, sensors network); contribute to transfer of knowledge from academic research to S2R programme during its whole duration, via scientific and technology watch.

2. *Adhesion*

The work should include further development of adhesion management tools and solutions for braking to map different adhesion conditions occurring in rail traffic. The activities should contribute to formulate new performance specifications for Adhesion Recovery Systems. Finally, improved requirements for Wheel Slide Protection (WSP) test procedures should be developed, followed by new specifications for Automatic Test benches.

The implementation of this action requires close collaboration with Roll2Rail project ('lighthouse' project resulting from H2020 call MG2.3-2014).[30]

This topic is complementary with topic S2R-OC-IP1-01-2016: Tools and methodologies supporting the development of next generation traction systems, and brakes. As specified in section 4.2.5 of S2R AWP for 2016, in order to facilitate the contribution to the achievement of S2R objectives, the options regarding 'complementary grants' of the S2R Model Grant

[30] However, as the EC Work Programme 2014-2015 does not contain sufficiently detailed requirements, the provisions on complementary grants in the S2R JU MGA are not mandatory for the beneficiaries of Roll2Rail project following take-over of the project by the JU, who may accept them on a voluntary basis, subject to their explicit agreement.

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.

For grants awarded under this topic for research and innovation actions it is expected that results contribute to European or international standards. Therefore, the respective option of Article 28.2 of the Model Grant Agreement will be applied.

The S2R JU considers that proposals requesting a contribution from the EU of around €13 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude the submission and selection of proposals requesting other amounts.

The S2R JU will only fund one proposal under this topic.

Expected Impacts: The most significant quantitative benefits brought by new technologies, methodologies and simulation tools developed within this action will include:

- a reduction of the traction system validation and certification costs through simplification, harmonisation of rules and replacing very expensive "on site" certification tests through more cost efficient simulations and/or static bench tests;
- a reduction in maintenance costs, ensuring high reliability and “maintenance oriented design” components and traction sub-system hardware completed by smart maintenance;
- and a reduction in traction energy consumption thanks to the use of higher energy efficiency technologies, significant weight reduction, technologies for potential hybrid traction, traction auxiliaries optimisation, etc.;
- noise reduction thanks to the development of methodologies of noise emission prediction and reduction coupled with solutions for adhesion management for brakes;
- Further important impacts can also be expected in the domains of reliability of sub-systems, braking distances, and train capacity.

Type of Action: Research and Innovation Actions

S2R-CFM-IP1-02-2016 – Development of new technological concepts, standard specifications and architectures for train control and monitoring, with specific applications in train-to-ground communications and high safety electronic control of brakes

Specific challenge: There are two main specific challenges concerning the train control and monitoring and safe control of brakes:

1. The Train Control and Monitoring System (TCMS) is the brain and the communications backbone of the train, which has some essential roles on vehicle performance. The next generation of TCMS should include wireless capabilities, should provide seamless coupling, enhanced interoperability, throughput and reliability, should be built on a new architecture based on distributed functions with standardised interfaces, while supporting safety-critical and security functionalities, and should offer easier authorisation procedures and self-configuration.
2. In order to achieve the required safety (Safety Integrity Level (SIL)4 is required on overall brake system level), today's brake controls still rely on hardwired and/or pneumatic communication signals and on pneumatic brake control functions with major disadvantages like coherence of pneumatic and electronic system. The future need would be to have an electronic HW-SW hardware-software platform to manage all the braking functions (service, holding, emergency, safety brake, wheel slide protection) according to proper high safety levels (SIL3, SIL4).

Scope: Proposals should address both challenges mentioned above, in line with the Shift2Rail Multi-Annual Action Plan (MAAP):

Regarding *train control and monitoring*, the research and innovation activities should start with the development of the specifications of the next generation of TCMS and then having them as input evolve within the following four complementary and cross dependant work streams:

- *Wireless TCMS*: The work should include the implementation of train-to-ground communications technology, which are included in the IEC 61375-2-6, in order to validate its applicability and interoperability. This activity should include at least two independent implementations (for both sides: train and ground) to be tested under real conditions. The work should include the train-to-train wireless communication (non-coupled consists) in view to support Shift2Rail IP2's Virtual Coupling concept;
- *Drive-by-Data*: The proposals should include the development of TCMS to provide SIL4 capabilities which allows the integration of safety-critical functions (incl. signalling). Special attention should be paid to the aviation sector, where similar technologies are in used (ARINC 664 and SAE AS6802). The work should include defining specification, RAMS studies, final architecture and interfaces;
- Develop *Functional Distribution Architecture* based on a functional distribution among a reduced number of CPUs, where each function interfaces the TCMS through a

standardised framework (equivalent to AUTOSAR/MICROSAR in the car industry or ARINC 653 in aviation); only re-commissioning towards the framework is needed then. Definition of the application profiles for the rolling stock subsystems (according to CENELEC FBS) will also be needed. The scope of this activity is the development of its detailed specification (including application profiles) and final architecture and interfaces, where the Functional Open Coupling (FOC) concept should be taken into consideration where appropriate;

- *Virtual placing in the market*: Definition and implementation of ECN/ETB conformance testing will be included in the proposals. Development of a methodology, architecture and interfaces for the TCMS virtual certification simulation framework and the supporting toolbox for the monitoring and testing of the new generation of TCMS will also be part of the work.

Regarding *safe control for brakes*, their future relies upon an electronic hardware-software architecture, compliant with High Safety Integrity Level (SIL3-SIL4), particularly oriented to be applied in Brake Control solutions, where the safety functions allocation will be transferred from traditional pneumatic components to electronic modules. The work should address specifications and high level architectures, ensuring consistency with the requirements for TCMS safe electronics.

The implementation of this action requires close collaboration with Roll2Rail project ('lighthouse' project resulting from H2020 call MG2.2-2014).[31]

This topic is complementary with topic S2R-OC-IP1-02-2016: Technology feasibility studies supporting the development of next generation TCMS, and safe control for brakes. As specified in section 4.2.5 of S2R AWP for 2016, 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.

For grants awarded under this topic for research and innovation actions it is expected that results contribute to European or international standards. Therefore, the respective option of Article 28.2 of the Model Grant Agreement will be applied.

The S2R JU considers that proposals requesting a contribution from the EU of around €6 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude the submission and selection of proposals requesting other amounts.

The S2R JU will only fund one proposal under this topic.

[31] However, as the EC Work Programme 2014-2015 does not contain sufficiently detailed requirements, the provisions on complementary grants in the S2R MGA are not mandatory for the beneficiaries of Roll2Rail project following take-over of the project by the JU, who may accept them on a voluntary basis, subject to their explicit agreement.

Expected impact: Regarding *train control and monitoring*, the most significant benefits to be obtained are:

- Production of a comprehensive set of agreed requirements as the general specification for the next generation of TCMS;
- Implementation, validation and interoperability assessment of the new train-to-ground communication standard, notably according to the IEC 61375-2-6, to allow the deployment of interoperable remote maintenance applications to reduce LCC and increase operational reliability;
- Definition, implementation and validation of ETB/ECN conformance testing, as a way for LCC reduction;
- Definition of the application profiles, positively impacting interoperability and paving the way for applications like the Functional Open Coupling to improve capacity, flexibility and to reduce LCC;
- Detailed specification and architecture definition (including interfaces) of the Drive-by-Data concept to allow its implementation in a second phase, targeting the elimination of train lines, the integration of safety-critical functions (like signalling) and therefore obtaining a LCC reduction and operational reliability improvement.
- Detailed specification and architecture definition (including interfaces) of the Functional Distribution concept leading to a reduction of LCC and improvement of operational reliability;
- Detailed specification and architecture definition (including interfaces) of the Virtual certification framework and its supporting toolbox to enable further reductions in LCC.

Regarding *safe control for brakes*, the most significant benefits might be expected, once the technologies are fully implemented and deployed, from specification and concepts for Architectures of High Safety Integrity Level Platforms, particularly oriented to be applied in Brake Control solutions that will help to:

- reduce braking distances at a defined confidence level thus allowing capacity increase in traffic,
- obtain LCC reductions through reduction in capital costs for the brake system, which comes from a higher standardisation of electronic components (Ethernet communication, “fit for function”)
- and to further obtain LCC cost reductions through to easier diagnosis and debugging of electronic solutions.

Type of action: Research and Innovation Actions

S2R-CFM-IP3-01-2016 – Research into enhanced track and switch and crossing system

Specific Challenge: In the coming years, we can expect a strong growth in transport demand, accompanied by the ever-increasing customer expectations on quality of service. With respect to the rail infrastructure, in order to face these demands, the challenge will consist in enhancing and optimising the switch & crossings and track systems in order to ensure the optimal line usage and capacity. The challenge will also include investigating novel ways of extending the life of bridges and tunnel assets through new approaches to maintaining, repairing and upgrading these structures. The focus should be on innovative design and optimisation of these assets, considering the needs and costs across their whole life including maintenance. A holistic, whole system-approach should be developed and adopted.

Scope**:** The proposed research should address all the different aspects of optimisation of switches & crossings, tracks, bridges and tunnels listed below, in line with the Shift2Rail Multi-Annual Action Plan (MAAP):

- Deterioration mechanisms should be identified and different methods to detect damage, reduce damage and prolong life should be developed. Here an important area is to identify and categorise suitable improved materials for switches & crossings and tracks. Methods for improved prediction, monitoring and mitigation of deterioration and lateral instability of rails and switches & crossings should be developed;
- For bridges and tunnels inspection technology with good precision, repeatability and reproducibility, together with capability of detecting damages at early stage is an important area. Methods for improving performance of bridges and tunnels should be proposed;
- Noise and vibrations are important aspects of the solutions studied. Both rolling noise and squeal noise should be addressed and the impact of different innovative solutions on generation, translation and emission of noise should be evaluated;
- One additional outcome of the research should consist in proposing methodologies, procedures, criteria and possible demonstration objects that can be employed to evaluate the feasibility of proposed solutions for modified switches & crossings, tracks and civil structures.

This action will be complementary to the actions carried out in S2R-OC-IP3-01-2016: Research into new radical ways of changing trains between tracks. As specified in section 4.2.5 of S2R AWP for 2016, 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.

The S2R JU considers that proposals requesting a contribution from the EU of around €2.8 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude the submission and selection of proposals requesting other amounts.

The S2R JU will only fund one proposal under this topic.

Expected Impact: Actions will contribute to tracks and civil structures by increasing the lifetime, decreasing traffic disturbances, and identifying new solutions for tracks, switches & crossings, bridges and tunnels. Decreased disturbances will, in addition to improved structures, follow from enhanced and less intrusive construction, inspection, and maintenance procedures.

Further, there will be a reduction in asset deterioration through more robust and reliable products, procedures and processes. Decreased noise and vibration impact will in addition allow more traffic in sensitive line sections.

In order to improve reliability, reduce costs and environmental impact including noise emissions and at the same time improve safety, the actions will support the required improvement, which in turn will help to achieve increased lifetime and decreased traffic disturbances.

Type of Action: Research and Innovation Actions

S2R-CFM-IP3-02-2016 – Intelligent maintenance systems and strategies

Specific Challenge: Taking into account the expected growth in transport demand and the ever-increasing customer expectations on quality of service, there is a need for a step change in the productivity of the infrastructure assets. These assets will need to be managed in a more holistic, intelligent and consistent way, using lean operational practices and smart technologies that can ultimately contribute to improving the reliability and responsiveness of customer service and the whole economics of rail transportation.

It is evident that a quantum step in rail maintenance is required to make the infrastructure fit for the upcoming challenges and achieve ambitious targets.

The ambition is to use a holistic railway asset management system approach in order to:

- Identify the most critical assets to be managed with the related parameters and items to be measured and monitored;
- Provide integration of these data/information in an intelligent asset management system, giving the possibility of their usage in novel ways;
- Substantially improve the availability and reliability of railway infrastructure through adapted maintenance strategies, predictive risk and condition based maintenance, and usage of decision support systems, new and advanced working methods, tools and equipment, maintenance plant and logistical solutions.

Scope: The research and innovation activities should evolve with three interdependent work streams, in line with the Shift2Rail Multi-Annual Action Plan (MAAP):

- Identify, measure and collect data/information related to the status of the rail infrastructural assets focusing on cutting-edge on-board and wayside innovative technologies and approaches for measuring and monitoring the root causes of degradation/failure of the most critical assets (tracks, switch & crossings, signalling and railway operations);
- Manage heterogeneous data/information of railway infrastructural assets through open, standardised, seamless and secure approaches. The research shall cover aspects like transaction of IPR-protected B2B data, management of data with safety-critical impact, strict information assurance and related quality control procedures on data and quality gates. Activities shall address also how to generate knowledge from data/information - driven whenever necessary by the available domain knowledge - valid for life cycle management and intelligent maintenance planning module including: automatic detection of anomalies; discovering and describing the maintenance workflow processes and implementation of predictive models/algorithms of decaying infrastructure assets;
- Investigate intelligent asset management and execution strategies:

- Concepts for maintenance planning and decision support, risk- and condition-based maintenance strategies; decision support tools for maintenance management, resource planning and deployment and for RAMS&LCC based maintenance or system improvement including state, age of asset and root causes for maintenance;
- New and advanced working methods, tools and equipment and logistics solutions, supporting the LEAN execution of maintenance processes.

Activities and specific focus areas in the three work streams should be aligned in order to showcase a coherent and holistic approach (form one example) and demonstrate the potential effect and impact when working together.

The S2R JU considers that proposals requesting a contribution from the EU of around €7.3 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude the submission and selection of proposals requesting other amounts.

The S2R JU will only fund one proposal under this topic.

Expected Impact: Research and innovation activities are expected to result in an indicative reduction in the recurrent costs of rail operations within a range of 25-45%. Taking the context of the work streams into account, the lower operating costs will evolve from reductions maintenance costs (~25%) and increases in reliability of operation (~20%). Furthermore lean implementation strategies may amount up to 30% of total costs. Since proposed solutions can only address specific aspects, mentioned figures should apply towards those specific areas. The choice of the specific area should be justified by illustrating the total impact of the problem solved compared to other problem areas. Results should contribute to a Single European Railway Area and enhance interoperability.

Type of Action: Research and Innovation Actions

ANNEX II

2016 Open call for proposals for non-JU members – Topic descriptions

S2R-OC-IP1-01-2016 – Tools and methodologies supporting the development of next generation traction systems, and brakes

Specific Challenge: There are two main specific challenges concerning traction systems and management of wheel/rail adhesion:

1. *Traction systems*

The Traction drive sub-system is one of the main sub-systems of a train as it moves the train converting energy from an electrical source (directly or via a chemical source) into a mechanical one.

The physical domains to master are multiple: electrical, mechanical, thermal, and automatic. A large number of norms and regulations have to be taken into account for traction systems design, manufacturing, validation and certification. The challenge, at this point, is to develop and contribute to implementing new methodologies, tools, norms & standards of reliability, noise, virtual validation and certification, and smart maintenance.

2. *Adhesion*

The wheel-rail contact is normally not only a great source of uncertainty in the prediction of braking distances, but it can constitute a general bottleneck for the achievable braking effort of the train – and to a substantial degree for the tractive effort as well. Due to environmental as well as technical issues the properties of the rail-wheel contact are highly variable. This affects a large number of rail traffic characteristics, like headways, punctuality and especially safety. The challenge is to develop proper tools and methodologies enabling mapping of different adhesion conditions occurring in rail traffic and investigation of the effect of these methods to modify basic adhesion is the base to achieve optimal traction and braking effort in the future.

Scope*:* Proposals should address all the following elements, in line with the Shift2Rail Multi-Annual Action Plan (MAAP):

1. *Traction systems*

The proposals will supply technology or prospective marketing work with a long term vision on market needs, business models and technologies looking beyond the 2020 horizon use in real markets.

The work should include five streams:

- *Digitalisation and big data*: Establish benchmark of existing major trends, comparing them to other domains like consumer electronics, house connected objects, internet sectors, connected cars, etc. The progress beyond the benchmark will have to be analysed and recommendations provided on potential re-use of concepts or technologies from other sectors for traction components.
- *Prospective market studies*: Today, only short-term studies exist on market needs, usually not going beyond a three-year vision. As traction breakthrough innovation cycles are usually running over approximately ten years, long-term prospective market views are needed, analysing the expected impact of long-term market trends on traction solutions. For example the evolution of CO2 markets, or new energy cost scenarios, could change significantly the interest of hybrid traction. Evolution of Silicon carbide (SiC) high voltage semi-conductor from other industries, such as energy transmission and distribution, could impact traction solutions. All potential long term markets evolutions have to be analysed with potential impact on traction business models.
- *Eco-labelling*: The work should analyse and describe what type of eco-labelling could potentially be implemented for traction systems. It will include the analysis and recommendations as to the type of information, targets of the communication, benchmark and transfer of other existing approaches (example: cars, planes, consumer electronics), and potential channels of communication. The target would be to have comparable eco-label communication between railway sector companies and between railway and other transport modes. Energy, CO2 emissions, noise, air pollution, recyclability, electromagnetic emissions could be included in the studies.
- *Very high power density and energy density*: Currently, the existing energy storage technologies do not provide the needed energy and power density performances, apart from light rail vehicle applications, limiting the use of such technologies to progress on other train types, or hybrid vehicle, like regional trains or locomotives. The work should include research and development of tools and methodologies for technology transfer from other sectors, e.g. automotive, in order to bring higher technical performances to railways.
- Research on very high power density permanent magnet motors for wheel mechanical integration: Development of very high power density permanent magnet motors for wheel mechanical integration to achieve new distributed traction systems with high performance of adhesion. The work should go beyond current technology applications in other areas (i.e. trams) and develop new very high power density permanent magnet motors for wheel mechanical integration capable of offering high performances for, among other areas, high speed needs.

2. *Adhesion*

Topics for further optimisation of braking in low adhesion management situations will need to take into account the conformity assessment process. The work should also include support and expertise needed to trigger these changes, including:

- Analysis of existing regulation issues for adhesion management in braking;
- Comparison of more advanced adhesion management concepts with existing regulation;
- Identification of gaps between adhesion management concepts and regulation;
- Making proposals for solving these conflicts, notably by developing a specific roadmap;

This topic is complementary with topic S2R-CFM-IP1-01-2016: Development of concepts towards the next generation of traction systems and management of wheel/rail adhesion. As specified in section 4.2.5 of S2R AWP for 2016, 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.

The S2R JU considers that proposals requesting a contribution from the EU of around €1.1 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude the submission and selection of proposals requesting other amounts.

Expected Impact: The result of the work is expected to contribute to the achievement of life cycle cost minimisation. LCC reduction could be obtained notably thanks to a modification of traction specification, following the achievements in the stream of digitalisation and big data; and through adapting business models, following input from prospective market studies. An increase of line capacity could be expected if eco-labelling and positive environmental figures would encourage more passengers to use railway instead of other transport modes. Innovation within the domain of high power density permanent magnet motors will potentially bring better performances on HST Traction application. New methodologies and tools for adhesion management are expected to provide improvement in the domain of reliable braking distances under poor adhesion condition and noise reduction at train level.
Type of Action: Research and Innovation Actions

S2R-OC-IP1-02-2016 – Technology feasibility studies supporting the development of next generation TCMS, and safe control for brakes

Specific challenge: There are two main specific challenges concerning the *train control and monitoring* and *safe control of brakes*:

1. The Train Control and Monitoring System (TCMS) is the brain and the communications backbone of the train, which has some essential roles on vehicle performance. The next generation of TCMS should include wireless capabilities, should provide seamless coupling, enhanced interoperability, throughput and reliability, should be built on a new architecture based on distributed functions with standardised interfaces, while supporting safety-critical and security functionalities, and should offer easier certification procedures and self-configuration.
2. In order to achieve the required safety (Safety Integrity Level (SIL) 4 is required on overall brake system level), today's brake controls still rely on hardwired and/or pneumatic communication signals and on pneumatic brake control functions with major disadvantages like coherence of pneumatic and electronic system. The future is to have an electronic HW-SW platform to manage all the braking functions (service, holding, emergency, safety brake, wheel slide protection) according to proper high safety levels (SIL3, SIL4).

Scope: Proposals should address both challenges mentioned above, and include the following elements, in line with S2R Multi-Annual Action Plan (MAAP):

Regarding *train control and monitoring*, suitable technologies have to be identified and assessed in order to support the development of the new railway vehicle control and monitoring systems. Proposals should encompass the following three complementary and cross-dependant work streams:

- *Drive-by-data*: The work should include identification and technology feasibility studies of safety related (up to SIL4) communication technologies and architectures based on Ethernet to make TCMS capable of handling safety-critical functions (including signalling) without train safety lines. Special attention should be paid to the aviation sector, where similar technologies are in use (ARINC 664 and SAE AS6802). Technology gaps should be identified and adaptations for the rail sector proposed;
- *Functional Distribution Architecture*: The proposals should include identification and technology feasibility studies of an application framework software supporting the functional distribution concept. This concept should allow the execution of all functions on high performing end devices distributed along the vehicle, with different safety and integrity levels. Functions will be plugged in the framework and run isolated from each other with the aim at avoiding complete TCMS re-commissioning after any application change. Based on the technology used, it will be guaranteed that safety (e.g. brakes) and

non-safety (e.g. CCTV) relevant functions are feedback free and separated from each other. Research should start from already existing frameworks and concepts, like ARINC 653 (aviation) or AUTOSAR & MICROSAR (car industry). The standardised framework should abstract hardware and communication services. Technology gaps should be identified and adaptations for the rail sector proposed;

- *Virtual placing in the market*: The proposals should also include identification and technology feasibility studies for developing a distributed simulation framework to virtualise the train over heterogeneous communication networks (e.g. internet, LAN, train's ECN/ETB…) including hardware-in-the-loop capability and remote execution of functions.

Regarding *safe control for brakes*, criteria for certification have to be defined for higher safety levels through notified bodies, experts in rolling stock certification, which have dedicated know how within safety for electronics. Notified Bodies' competence as well competence in fields like automotive or avionics are preferred, bringing in "safety transversal knowledge" useful to possibly improve and simplify the railways safety related technology.

This topic is complementary with topic S2R-CFM-IP1-02-2016: Development of new technological concepts, standard specifications and architectures for train control and monitoring, with specific applications in train-to-ground communications and high safety electronic control of brakes. As specified in section 4.2.5 of S2R AWP for 2016, 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.

The S2R JU considers that proposals requesting a contribution from the EU of around €7 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude the submission and selection of proposals requesting other amounts.

Expected impact: Regarding *train control and monitoring*, the most significant expected benefits are:

- The technologies for the functional distribution architecture should lead to a reduction of the number of on-board computing devices, improved reliability, shortening the integration and (re)commissioning times and thus LCC reduction;
- Ability to implement the SIL4 functions in TCMS, which will be able then to perform safety-critical tasks without train lines and integrate signalling functions;
- The proposed simulation framework and its technologies should allow the execution of the 100% of the implemented train functions, with 100% of software coverage, through heterogeneous networks, to improve the operational reliability and reduce time and costs related to subsystem integration and train commissioning.

This research should be carried out in several phases. First, by month 3 a comprehensive state-of-the-art of the concerned technologies should be issued. Then, the project would be expected to start identifying appropriate technologies. Such identification should be finalised by month 12 and followed by issuing a comprehensive report. Finally, by the end of the project, the existing gaps should have been identified and the needed adaptations and modification should have been proposed.

Regarding *safe control for brakes*, the most significant expected benefits are:

- The criteria for certification should lead to easier and more reliable acceptance of a brake system and thus reduce costs and time-to-market;
- The safety transversal knowledge should improve and simplify railway safety technology and have a positive effect on LCC, maintainability and time-to-market.

Type of action: Research and Innovation Actions

S2R-OC-IP3-01-2016 – Research into new radical ways of changing trains between tracks

Specific Challenge**:** Taking into account the expected growth in transport demand and the ever-increasing customer expectations on quality of service, there is a need for ambitious research and a step, yet radical, change in the design and the technology of the track system, in particular the switches and crossing (S&C) sub-system. These systems need to be developed utilising the latest technological advances from others sectors and target maintenance free and degradation free assets. The innovation should lead to significant improvement of capacity, reliability, safety, investment and operating cost of these assets.

Scope**:** The research and innovation activities should evolve with three interdependent work streams, in line with the Shift2Rail Multi-Annual Action Plan (MAAP):

- Next Generation Control; Monitoring & Sensor Systems:

  The next generation of track and S&C design will incorporate intelligent self-diagnostics systems with the capability to self-adjust, self-correct, self-repair and self-heal within predefined system operating tolerances. The next generation systems will eliminate manual maintenance interventions. The system will have the capability to monitor not only its current state but also its future states and adapt to its environment and external factors.

- Next Generation Design; Materials & Components:

  Smart design and bespoke material science solutions should be considered targeting simplified systems with reduced complexity and fewer components. To progress beyond the current state of the art it will examine technology transfer opportunities from other industries. The wheel-rail interface will be optimised to enable the development of radically new mechanisms for switching a train from one line to another.

- Next Generation Kinematic Systems:

  The next generation S&C design will incorporate a completely new switching function using novel kinematic elements with radically different components and will be designed from a whole system perspective considering mechatronics technology.

This action will be complementary to the actions carried out in S2R-CFM-IP3-01-2016: Research into enhanced track and switch and crossing system. As specified in section 4.2.5 of S2R AWP for 2016, 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.

The S2R JU considers that proposals requesting a contribution from the EU of around €5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude the submission and selection of proposals requesting other amounts.

Expected Impact: A significant impact is expected from the technologies developed in this research and innovation action including:

- Improvement of capacity – a large improvement in line capacity and improvement in speed through new generation of switches;
- Reliability - all failure modes of current systems to be eliminated with new maintenance free and degradation free systems developed;
- Safety – the new systems must comply with relevant safety standards and address known safety issues which have resulted in past incidents in order to reduce the number and magnitude of incidents;
- Investment costs should be reduced and never increased;
- Significant LCC savings should be possible, thanks to new materials and maintenance.

Type of Action: Research and Innovation Actions

S2R-OC-IP4-01-2016 – Interoperability Framework governance, ensuring its market uptake and sustainability

Specific challenge: The development of multimodal travel information, planning and booking services could contribute to a better modal integration of different transport modes and reducing environmental impact of the transport sector, by fostering modal shift to more environmentally-friendly modes. The major obstacle impeding the emergence of such capabilities is the lack of interoperability between business applications due to the fragmentation and incompatibility of interchange formats and protocols both within and across transport sectors as well as between links in the supply chain. The Innovation Programme 4 of Shift2Rail "IT solutions for attractive railways" will develop a technical enabler addressing interoperability using new semantics technology in order to deliver a seamless customer experience. The challenge is to secure the confidence of the industry in the use of such new technology in order to promote its market uptake both in terms of performance (KPIs) and in terms of the maintenance and evolution of the Interoperability Framework. Such work is essential for the development of a coherent transport ecosystem and the proper integration of the rail sector. The provision of a sustainable base for the development of multimodal services will optimise the conditions for market uptake and business model sustainability and ensure a large adoption by the final end-users.

Scope: Proposals should address all the following domains in line with the Shift2Rail Multi-Annual Action Plan (MAAP):

The work should include the design of a proper governance and management structure for the "Interoperability framework" to ensure its continued relevance for the future evolution of the Single European Transport Area. A particular emphasis should be put on the design of use cases for end-users and stakeholders at each link of the supply chain.

The work should also aim at analysing the conditions for a market uptake of a multimodal market place supported by a semantic web of transportation. The sustainability of the proposed approach must be demonstrated with concrete market oriented activities and the definition of a roadmap. Identification of business opportunities, stakeholders, market restrictions and requirements, new value chains or digitalisation of processes will also be analysed.

The interoperability framework will support the end-user centric paradigm, which will offer novel user experience to customer. The work should thus aim at analysing the conditions for a large adoption by travellers of the travel companion approach, including for instance ethnographic studies.

The implementation of this action requires close collaboration with IT2Rail project ('lighthouse' project resulting from H2020 call MG2.2-2014).[32]

This topic is complementary with topics S2R-CFM-IP4-01-2015: Shopping, booking and ticketing of multimodal travel solutions, S2R-CFM-IP4-02-2015: Travel companion and tracking services and S2R-OC-IP4-02-2016: Interoperability Framework Converters in order to achieve consistency and ensure integrated system level delivery of IP4 concepts. As specified in section 4.2.5 of S2R AWP for 2016, 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.

The S2R JU considers that proposals requesting a contribution from the EU of around €2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude the submission and selection of proposals requesting other amounts.

Expected impact: In the field of the interoperability framework, the activities will aim at proposing measures and a management structure ensuring a large acceptance of the interoperability framework by the transport stakeholders from various modes. The acceptance of the interoperability framework will be a condition for a development of a true transport ecosystem and creation of multi-modal products for the benefit of the passengers, ultimately leading to the increase in the use of greener transport modes.

Type of action: Coordination and Support Actions

[32] However, as the EC Work Programme 2014-2015 does not contain sufficiently detailed requirements, the provisions on complementary grants in the S2R MGA are not mandatory for the beneficiaries of IT2Rail following take-over of the project by the JU, who may accept them on a voluntary basis, subject to their explicit agreement.

S2R-OC-IP4-02-2016 – Interoperability Framework Converters

Specific challenge: Currently the emergence of multimodal travel options and products is impeded by a lack of interoperability between different transport modes, and incentives for different operators to cooperate and create an ecosystem where common travel products or services could be created. The challenge is to mask the complexity of the transport ecosystem by providing an interoperability framework which is able to address the variability of standards and protocols existing in different transport modes. Annotation of data and common ontologies propose a systematic approach for the development of enabling 'translator' or 'converter' technology in order to manage data coming from different environments and sector-level advances in interchange formats and protocols such as Telematics Applications for Passenger Services Technical Specifications for Interoperability (TAP-TSI) or emerging sector driven initiatives such as Full Service Model (FSM).

Scope: Proposals should address all the following domains in line with the Shift2Rail Multi-Annual Action Plan (MAAP):

The work will aim at enhancing cost-reducing translator technology which draws from both the ontology repository, and the service registry, (of the correspondingly annotated services of IP4 eco-system participants) hosted by the Interoperability Framework. The activities should propose enhanced translator capabilities so that they can deal with the more complex misalignment of eco-system user services due to differences in business models or business flows, e.g. differences in the degree (loose or tight) of coupling between booking, payment and ticketing transactions.

The proposed works should focus on developing components which create mediation and translation between different standards and protocols, resulting in an automated discovery and configuration of heterogeneous systems from different transport modes, with a specific focus put on the railway sector. This is a necessary condition to ensure the scalability of the interoperability framework as it will improve its performance and promote the integration of new systems/services/actors, with reduced efforts and costs for the newcomers. The proposed developments should be in line with and enable a faster adaptation to the requirements stemming from TAP-TSI.

The implementation of this action requires close collaboration with IT2Rail project ('lighthouse' project resulting from H2020 call MG2.2-2014).[33]

This topic is complementary with topics S2R-CFM-IP4-01-2015: Shopping, booking and ticketing of multimodal travel solutions, S2R-CFM-IP4-02-2015: Travel companion and

[33] As the EC Work Programme 2014-2015 does not contain sufficiently detailed requirements, the provisions on complementary grants in the S2R MGA are not mandatory for the beneficiaries of IT2Rail project following take-over of the project by the JU, who may accept them on a voluntary basis, subject to their explicit agreement.

tracking services and S2R-OC-IP4-01-2016: Interoperability Framework governance, ensuring its market uptake and sustainability, in order to achieve consistency and ensure integrated system level delivery of IP4 concepts. As specified in section 4.2.5 of S2R AWP for 2016, 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.

The S2R JU considers that proposals requesting a contribution from the EU of around €1 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude the submission and selection of proposals requesting other amounts.

Expected impact: In the field of automated ontology mapping, the activities will aim at gaining enough performance in the management of heterogeneous set of data to enable the development of a broadly accepted semantic web of transportation, thus providing a solid and scalable solution supporting a broad development of multimodal services, fostering a broader inclusion of railway operators.

Type of action: Research and Innovation Actions

ANNEX III Indicators and Scoreboard of KPIs

TABLE I - Horizon 2020 Key Performance Indicators[34] common to all JTI JUs

	Correspondence to general Annex 1	Key Performance Indicator	Definition/Responding to question	Type of data required	Data to be provided by	Baseline at the start of H2020 (latest available)	Target at the end of H2020	Automated
INDUSTRIAL LEADERSHIP	12	SME - Share of participating SMEs introducing innovations new to the company or the market (covering the period of the project plus three years);	Based on Community Innovation Survey (?). Number and % of participating SMEs that have introduced innovations to the company or to the market;	Number of SMEs that have introduced innovations;	H2020 beneficiaries through project reporting	n.a. [new approach under H2020]	50%	Yes
	13	SME - Growth and job creation in participating SMEs	Turnover of company, number of employees	Turnover of company, number of employees;	H2020 beneficiaries through project reporting	n.a. [new approach under H2020]	to be developed based on FP7 ex-post evaluation and /or first H2020 project results	Yes
SOCIETAL CHALENGES	14	Publications in peer-reviewed high impact journals in the area of the JTI	The percentage of papers published in the top 10% impact ranked journals by subject category.	Publications from relevant funded projects (DOI: Digital Object Identifiers); Journal impact benchmark (ranking) data to be collected by commercially available bibliometric databases.	H2020 beneficiaries through project reporting; Responsible Directorate/Service (via access to appropriate bibliometric databases)	n.a. [new approach under H2020]	[On average, 20 publications per €10 million funding (for all societal challenges)]	Yes

[34] (based on Annex II to Council Decision 2013/743/EU)

	Correspondence to general Annex 1	Key Performance Indicator	Definition/Responding to question	Type of data required	Data to be provided by	Baseline at the start of H2020 (latest available)	Target at the end of H2020	Automated
	15	Patent applications and patents awarded in the area of the JTI	Number of patent applications by theme; Number of awarded patents by theme	Patent application number	H2020 beneficiaries through project reporting; Responsible Directorate/Service (via worldwide search engines such as ESPACENET, WOPI)	n.a. [new approach under H2020]	On average, 2 per €10 million funding (2014 - 2020) RTD A6	Yes
	16	Number of prototypes testing activities and clinical trials[35]	Number of prototypes, testing (feasibility/demo) activities, clinical trials	Reports on prototypes, and testing activities, clinical trials	H2020 beneficiaries through project reporting	n.a. [new approach under H2020]	[To be developed on the basis of first Horizon 2020 results]	Yes
	17	Number of joint public-private publications in projects	Number and share of joint public-private publications out of all relevant publications.	Properly flagged publications data (DOI) from relevant funded projects	H2020 beneficiaries through project reporting; Responsible Directorate/Service (via DOI and manual data input-flags)	n.a. [new approach under H2020]	[To be developed on the basis of first Horizon 2020 results]	Yes
	18*	New products, processes, and methods launched into the market	Number of projects with new innovative products, processes, instruments, methods, technologies	Project count and drop down list allowing to choose the type processes, products, instruments, methods, technologies	H2020 beneficiaries through project reporting	n.a. [new approach under H2020]	[To be developed on the basis of first Horizon 2020 results]	Yes
EVALUATION	NA	Time to inform (average time in days) all applicants of the outcome of the evaluation of their application from the final date for submission of completed proposals	To provide applicants with high quality and timely evaluation results and feedback after each evaluation step by implementing and monitoring a high scientific level peer reviewed process	Number of days (average)	Joint Undertaking	FP7 latest know results		Yes

[35] Clinical trials are IMI specific

	Correspondence to general Annex 1	Key Performance Indicator	Definition/Responding to question	Type of data required	Data to be provided by	Baseline at the start of H2020 (latest available)	Target at the end of H2020	Automated
	NA	Time to inform (average time in days) successful applicants of the outcome of the evaluation of their application from the final date for submission of completed proposals		Number of days (average)	Joint Undertaking	FP7 latest know results		Yes
	NA	Redress after evaluations	To provide applicants with high quality and timely evaluation results and feedback after each evaluation step by implementing and monitoring a high scientific level peer reviewed process	Number of redresses requested	Joint Undertaking	FP7 latest know results		
GRANTS	NA	Time to grant measured (average) from call deadline to signature of grants	To minimise the duration of the granting process aiming at ensuring a prompt implementation of the Grant Agreements through a simple and transparent grant preparation process	Cumulatively in days Average under H2020 (days) TTG < 270 days (as %of GAs signed)	Joint Undertaking (automatized)	n.a. [new approach under H2020]		Yes
	NA	Time for signing grant agreements from the date of informing successful applicants (average values)		Average under H2020 (days)	Joint Undertaking	n.a. [new approach under H2020]		Yes
AUDITS	NA	Error rate		% of common representative error; % residual error	CAS	n.a. [new approach under H2020]		Yes
	NA	Implementation of ex-post audit results		Number of cases implemented; in total €million; ´of cases implemented/total cases	CAS	n.a. [new approach under H2020]		Yes

	Correspondence to general Annex 1	Key Performance Indicator	Definition/Responding to question	Type of data required	Data to be provided by	Baseline at the start of H2020 (latest available)	Target at the end of H2020	Automated
PAYMENTS	NA	Time to pay (% made on time) -pre-financing - interim payment -final payment	To optimize the payments circuits, both operational and administrative, including payments to experts	Average number of days for Grants pre-financing, interim payments and final payments; Average number of days for administrative payments; Number of experts appointed	Joint Undertaking	FP7 latest know results	-pre-financing (30 days) - interim payment (90 days) -final payment ((90days)	Yes
HR	NA	Vacancy rate (%)		% of post filled in, composition of the JU staff [36]	Joint Undertaking	n.a. [new approach under H2020]		
JU EFFICIENCY	NA	Budget implementation/execution: 1. % CA to total budget 2. % PA to total budget	realistic yearly budget proposal, possibility to monitor and report on its execution, both in commitment (CA) and payments (PA), in line with sound financial management principle	% of CA and PA	Joint Undertaking		100% in CA and PA	Yes
	NA	Administrative Budget: Number and % of total of late payments	realistic yearly budget proposal, possibility to monitor and report on its execution in line with sound financial management principle	Number of delayed payments % of delayed payments (of the total)	Joint Undertaking			Yes

NOTES:

18* This indicator is not a legally compulsory one, but it covers several additional specific indicators requested for more societal challenges by the services in charge.

[36] Additional indicators can be proposed/discussed with R.1 and/or DG HR

TABLE II - Indicators for monitoring H2020 Cross-Cutting Issues[37] common to all JTI JUs

Correspondence in the general Annex 2	Cross-cutting issue	Definition/Responding to question	Type of data required	Data to be provided by	Data to be provided in/to	Direct contribution to ERA	Automated
2	Widening the participation	2.1 Total number of participations by EU-28 Member State	Nationality of H2020 applicants & beneficiaries (number of)	H2020 applicants & beneficiaries at the submission and grant agreement signature stage	JU AAR RTD Monitoring Report	YES	Yes
		2.2 Total amount of EU financial contribution by EU-28 Member State (EUR millions)	Nationality of H2020 beneficiaries and corresponding EU financial contribution	H2020 beneficiaries at grant agreement signature stage	JU AAR RTD Monitoring Report	YES	Yes
NA		Total number of participations by Associated Countries	Nationality of H2020 applicants & beneficiaries (number of)	H2020 applicants & beneficiaries at the submission and grant agreement signature stage	JU AAR RTD Monitoring Report	YES	Yes
NA		Total amount of EU financial contribution by Candidate Country (EUR millions)	Nationality of H2020 beneficiaries and corresponding EU financial contribution	H2020 beneficiaries at grant agreement signature stage	JU AAR RTD Monitoring Report	YES	Yes
3	SMEs participation	3.1 Share of EU financial contribution going to SMEs (Enabling & industrial tech and Part III of Horizon 2020)	Number of H2020 beneficiaries flagged as SME; % of EU contribution going to beneficiaries flagged as SME	H2020 beneficiaries at grant agreement signature stage	JU AAR RTD Monitoring Report		Yes
6	Gender	6.1 Percentage of women participants in H2020 projects	Gender of participants in H2020 projects	H2020 Beneficiaries through project reporting		YES	Yes

[37] (based on Annex III to Council Decision 2013/743/EU)

Correspondence in the general Annex 2	Cross-cutting issue	Definition/Responding to question	Type of data required	Data to be provided by	Data to be provided in/to	Direct contribution to ERA	Automated
		6.2 Percentage of women project coordinators in H2020	Gender of MSC fellows, ERC principle investigators and scientific coordinators in other H2020 activities	H2020 beneficiaries at the grant agreement signature stage		YES	Yes
		6.3 Percentage of women in EC advisory groups, expert groups, evaluation panels, individual experts, etc.	Gender of memberships in advisory groups, panels, etc.	Compiled by Responsible Directorate/ Service /Joint Undertaking based on existing administrative data made available by the CSC		YES	
7	International cooperation	7.1 Share of third-country participants in Horizon 2020	Nationality of H2020 beneficiaries	H2020 beneficiaries at the grant agreement signature stage	JU AAR RTD Monitoring Report	YES	Yes
		7.2 Percentage of EU financial contribution attributed to third country participants	Nationality of H2020 beneficiaries and corresponding EU financial contribution	H2020 beneficiaries at the grant agreement signature stage	JU AAR RTD Monitoring Report	YES	Yes
9	Bridging from discovery to market [38]	9.1 Share of projects and EU financial contribution allocated to Innovation Actions (IAs)	Number of IA projects	Project Office – at GA signature stage he/she will be required to flag on SYGMA. Responsible Directorate/Service (WP coordinator)/Joint Undertaking - via tool CCM2	JU AAR RTD Monitoring Report		Yes
		9.2 Within the innovation actions, share of EU financial contribution focussed on demonstration and first-of-a-kind activities	Topics properly flagged in the WP; follow-up at grant level	Responsible Directorate/Service (WP coordinator)/Joint Undertaking - via tool CCM2	JU AAR RTD Monitoring Report		Yes

[38] This indicator (9.2) is initially intended to monitor the Digital Agenda (its applicability could be only partial)

Correspondence in the general Annex 2	Cross-cutting issue	Definition/Responding to question	Type of data required	Data to be provided by	Data to be provided in/to	Direct contribution to ERA	Automated
NA		Scale of impact of projects (High Technology Readiness Level)	Number of projects addressing TRL[39] between…(4-6, 5-7)?	Joint Undertaking	JU AAR RTD Monitoring Report		
11	Private sector participation	11.1 Percentage of H2020 beneficiaries from the private for profit sector	Number of and % of the total H2020 beneficiaries classified by type of activity and legal status	H2020 beneficiaries at grant agreement signature stage	JU AAR RTD Monitoring Report		Yes
		11.2 Share of EU financial contribution going to private for profit entities (Enabling & industrial tech and Part III of Horizon 2020)	H2020 beneficiaries classified by type of activity; corresponding EU contribution	H2020 beneficiaries at grant agreement signature stage	JU AAR RTD Monitoring Report		Yes
12	Funding for PPPs	12.1 EU financial contribution for PPP (Art 187)	EU contribution to PPP (Art 187)	Responsible Directorate/Service	JU AAR RTD Monitoring Report		Yes
		12.2 PPPs leverage: total amount of funds leveraged through Art. 187 initiatives, including additional activities, divided by the EU contribution	Total funding made by private actors involved in PPPs - in-kind contribution already committed by private members in project selected for funding - additional activities (i.e. research expenditures/investment of industry in the sector, compared to previous year)	Joint Undertaking Services	JU AAR RTD Monitoring Report		
13	Communication and dissemination	13.3 Dissemination and outreach activities other than peer-reviewed publications - [Conferences, workshops, press releases, publications, flyers, exhibitions, trainings, social media, web-sites, communication campaigns (e.g radio, TV)]	A drop down list allows to choose the type of dissemination activity. Number of events, funding amount and number of persons reached thanks to the dissemination activities	H2020 Beneficiaries through project reporting	JU AAR RTD Monitoring Report	YES	Yes

[39] TRL: Technology Readiness Level

Correspondence in the general Annex 2	Cross-cutting issue	Definition/Responding to question	Type of data required	Data to be provided by	Data to be provided in/to	Direct contribution to ERA	Automated
14	Participation patterns of independent experts	14.2 Proposal evaluators by country	Nationality of proposal evaluators	Responsible Directorate /Service/Joint Undertaking in charge with the management of proposal evaluation			
		14.3 Proposal evaluators by organisations' type of activity	Type of activity of evaluators' organisations	Responsible Directorate /Service/Joint Undertaking in charge with the management of proposal evaluation		YES	
NA	Participation of RTOs and Universities	Participation of RTO[40]s and Universities in PPPs (Art 187 initiatives)	Number of participations of RTOs to funded projects and % of the total Number of participations of Universities to funded projects and % of the total % of budget allocated to RTOs and to Universities	H2020 beneficiaries at the grant agreement signature stage	JU AAR RTD Monitoring Report	YES	Yes
NA	Ethics	The objective is ensuring that research projects funded are compliant with provisions on ethics efficiently	% of proposals not granted because non-compliance with ethical rules/proposals invited do grant (target 0%); time to ethics clearance 5target 45 days)[41]	Responsible Directorate /Service/Joint Undertaking	JU AAR RTD Monitoring Report		

Notes:
*H2020 applicants - all those who submitted H2020 proposals
*H2020 beneficiaries - all those who have signed a H2020 Grant Agreement
*Responsible Directorate - DG RTD Directorates and R&I DGs family in charge with management of H2020 activities
*Services -Executive Agencies and other external bodies in charge with H2020 activities
*Project officer - is in charge of managing H2020 projects in Responsible Directorate/Service including Executive Agencies

[40] RTO: Research and Technology Organisation
[41] Data relates to pre-granting ethics review. This time span runs in parallel to granting process.

TABLE III - Key Performance Indicators specific for the S2R JU

#	Key Performance Indicator	Objective	Data to be provided by	Baseline at the start of H2020	Target at the end of H2020	Automated
S2R						
1	% reduction in the costs of developing, maintaining, operating and renewing infrastructure and rolling stock and increase energy efficiency compared to "State-of-the-art"	Reduce the life-cycle cost of the railway transport system	JU	"State-of-the-art" 2014	> 50 %	No
2	% increase the capacity of railway segments to meet increased demand for passenger and freight railway services compared to "State-of-the-art" 2014	Enhance the capacity of the railway transport system	JU	"State-of-the-art" 2014	100%	No
3	% decrease in unreliability and late arrivals compared to "State-of-the-art" 2014	Increase in the quality of rail services	JU	"State-of-the-art" 2014	> 50%	No
4	Reduce noise emissions and vibrations linked to rolling stock and respectively infrastructure compared to "State-of-the-art" 2014	Reduce the negative externalities linked to railway transport	JU	"State-of-the-art" 2014	> 3 - 10 dBA	No
5	Addressing open points in TSIs, compared to "State-of-the-art" 2014	Enhance interoperability of the railway system	JU	"State-of-the-art" 2014		No
6	Number of Integrated Technology Demonstrators (ITDs) and System Platform demonstrations	Improve market uptake of innovative railway solutions through large-scale demonstration activities	JU	tbd in the Multi-Annual Action Plan		Yes

#	Key Performance Indicator	Objective	Data to be provided by	Baseline at the start of H2020	Target at the end of H2020	Automated
7	Share of the fund allocated to the different Innovation Programmes and to cross-cutting themes	Ensure that funding covers the railway system as a whole	JU	n.a.	> 80%	No
8	Percentage of topics resulting in signature of GA	Ensure a sufficiently high call topics success rate	JU	n.a.	> 90%	Yes
9	% of resources consumption versus plan (members only)	WP execution by members - resources	JU	n.a.	> 80%	Yes
10	% of deliverables available versus plan (members only)	WP execution by members - deliverables	JU	n.a.	> 80%	Yes

ANNEX IV List of members of S2R JU other than the Union

NAME OF MEMBER	CONSTITUENT ENTITIES OF CONSORTIA	COUNTRY
AERFITEC Consortium	*AERNNOVA AEROSPACE S.A.U.*	ES
	FIDAMC	ES
	FUNDACION TECNALIA RESEARCH & INNOVATION	ES
ALSTOM Transport SA		FR
Amadeus IT Group SA		ES
ANSALDO STS S.p.A.		IT
AZD Praha s.r.o.		CZ
Bombardier Transportation GmbH		DE
Competitive Freight Wagon Consortium (CFW)	*Contraffic GmbH*	DE
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	Waggonbau Niesky GmbH	DE
	Centro de Estudios e Investigaciones Técnicas (CEIT)	ES
	Verband der Bahnindustrie in Deutschland (VDB)	DE
Construcciones y Auxiliar de Ferrocarriles		ES
Deutsche Bahn AG		DE
DIGINEXT		FR
EUropean Rail Operating community Consortium (EUROC)	*Infraestruturas de Portugal, S.A.*	PT
	BLS AG	CH
	CP	PT
	Finnish Transport Agency	FI
	ÖBB-Infrastruktur AG	AT
	Polskie Koleje Państwowe S.A. (PKP)	PL
	PRORAIL B.V.	NL
	Rede Ferroviária Nacional (REFER)	PT
	Schweizerische Bundesbahnen (SBB)	CH
	Slovenske zeleznice (SZ)	SI
	Türkiye Cumhuriyeti Devlet Demiryollari (TCDD)	TR
Faiveley Transport		FR
HaCon Ingenieurgesellschaft mbH		DE
INDRA SISTEMAS S.A.		ES
Kapsch CarrierCom AG		AT
Knorr-Bremse Systems für Schienenfahrzeuge GmbH		DE
MER MEC S.p.A		IT
Network Rail Infrastructure Limited		UK

Siemens Aktiengesellschaft		DE
Smart DeMain (SDM) consortium	*Strukton Rail BV*	NL
	ACCIONA INFRAESTRUCTURAS SA	ES
	Deutsches Zenttrum für Luft-und Raumfahrt e.V. (DLR)	DE
	Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.	DE
	Centro de Estudios de Materiales y Control de Obra S.A	ES
Smart Rail Control (SmartRaCon) consortium	*Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)*	DE
	Centro de Estudios e Investigaciones Técnicas (CEIT)	ES
	FONDATION DE COOPERATION SCIENTIFIQUE RAILENIUM	FR
	Nottingham Scientific Ltd	UK
Société Nationale des Chemins de Fer Français Mobilités (SNCF Mobilités)		FR
Swi'Tracken consortium	*FONDATION DE COOPERATION SCIENTIFIQUE RAILENIUM*	FR
	UNIVERSIDADE DO PORTO	PT
	TATASTEEL	FR
	UNIVERSIDAD DEL PAIS VASCO	ES
	UNIVERSIDADE DO MINHO	PT
	VOSSLOH-COGIFER	FR
	INSTITUT FÜR ZUKUNFTSSTUDIEN UND TECHNOLOGIEBEWERTUNG	DE
	EGIS RAIL	FR
	GROUPE EUROTUNNEL SA	FR
	TRONICO ALCEN	FR
Patentes Talgo S.L.U.		ES
THALES		FR
Trafikverket		SE
Virtual Vehicle Austria consortium+ (VVAC+)	*Kompetenzzentrum - Das virtuelle Fahrzeug, Forschungsgesellschaft mbH (Virtual Vehicle)*	AT
	FCP Firtsch, Chiari & Partner ZT GmbH	AT
	Getzner Werkstoffe GmbH	AT
	Kirchdorfer Fertigteilholding GmbH	AT
	Plasser&Theurer GmbH	AT
	voestalpine Schienen GmbH	AT
	voestalpine VAE GmbH	AT
	Wiener Linien GmbH & Co KG	AT
	AVL List GmbH	AT
	PJM Messtechnik GmbH	AT
	TATRAVAGONKA a.s.	SK

	AC2T research GmbH	AT
	Materials Center Leoben Forschung GmbH	AT