ANNUAL ACTIVITY
REPORT 2017

29 June 2018

In accordance with Article 20 of the Statutes of the S2R JU annexed to Council Regulation (EU) No 642/2014 and with Article 20 of the Financial Rules of the S2R JU.

The annual activity report will be made publicly available after its approval by the Governing Board.

Contents

FACTSHEET

Name	Shift2Rail Joint Undertaking (S2R JU)
Objectives	The Shift2Rail Joint Undertaking is a public-private partnership in the rail sector, providing a platform for cooperation that drives innovation in the years to come. The S2R JU pursues research and innovation (R&I) activities in support of the achievement of the Single European Railway Area and should improve the attractiveness and competitiveness of the European rail system. The S2R JU contributes to: • a 50 % reduction of the life-cycle cost of the railway transport system (i.e. costs of building, operating, maintaining and renewing infrastructure and rolling stock), • a 100 % increase in the capacity of the railway transport system, • a 50 % increase in the reliability and punctuality of rail services (measured as a 50 % decrease in unreliability and late arrivals). The S2R JU shall propose innovative solutions to be explored, tested and demonstrated in operational environment and/or "zero on site" to achieve market uptake. Beyond that, with the deployment of its innovative solutions the S2R JU will foster connections between people, regions, cities, and businesses, supporting the socioeconomic objectives of the Union
Founding Legal Act	Council Regulation (EU) No 642/2014 of 16 June 2014 establishing the Shift2Rail Joint Undertaking[1] (S2R Regulation)
Executive Director (ED)	Mr Carlo M. Borghini, as from 16 May 2016
Governing Board (S2R GB)	*EC members (at 31/12/2017)*: • *Henrik HOLOLEI, DG MOVE* • *BALDWIN Matthew, MOVE DG 2* *EC alternate (at 31/12/2017):* • *METTHEY Jack (RTD.I)* • *Clara DE LA TORRE, DG RTD* *Industry members (at 31/12/2017):* • *ALSTOM Nicolas CASTRES-SAINT-MARTIN* • *ANSALDO STS Nadia MAZZINO* • *AZD Praha Vladimir KAMPIK* • *BOMBARDIER TRANSPORTATION Philippe OGIER* • *CAF José GORTAZAR* • *DEUTSCHE BAHN Kay EULER* • *EUROC Thomas PETRASCHEK* • *HACON Lars DEITERDING* • *INDRA Jose Miguel Rubio SANCHEZ* • *KNORR - BREMSE Martin DEUTER* • *NETWORK RAIL (Industrial Spokesperson) Andy DOHERTY* • *SIEMENS Roland EDEL* • *SMARTDEMAIN Henk SAMSON* • *SMARTRACON Michael Meyer zu HÖRSTE*

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[1]   OJ L 177, 17.6.2014, p. 9

	- *SNCF Carol DENOST* - *THALES Alberto PARRONDO* - *TRAFIKVERKET Bo OLSSON* - *VVAC+ Filip KITANOSKI* ***Industry alternates (at 31/12/2017):*** - *ALSTOM Sophie PERROCHEAU* - *ANSALDO STS Antonella TROMBETTA* - *AZD Praha Michal PAVEL* - *BOMBARDIER TRANSPORTATION Richard FRENCH* - *CAF Aitor GALARZA* - *DEUTSCHE BAHN Ralf MARXEN* - *EUROC (to be appointed)* - *HACON Rolf GOOßMANN* - *INDRA Javier Rivilla LIZANO* - *KNORR - BREMSE Johannes GRAEBER* - *NETWORK RAIL Graham HOPKINS* - *SIEMENS Jürgen SCHLACHT* - *SMARTDEMAIN Javier Bonilla DÍAZ* - *SMARTRACON Jaizki MENDIZABAL* - *SNCF Christophe Chéron* - *THALES Yves PERREAL* - *TRAFIKVERKET Christer LOFVING* - *VVAC+ Erik STOCKER* ***Other participants (at 31/12/2017):*** - *Carlo M BORGHINI Executive Director of the S2R JU* ***Observers (at 31/12/2017):*** - *Josef DOPPELBAUER* - *Sebastien STICHEL* - *Miroslav HALTUF*
Other bodies	Scientific Committee (SC) States Representatives Group (SRG) Innovation Programmes' Steering Committees (IP SteeCos)
Staff	20 (On-going staff recruitment) at 31 December 2017
2017 Budget	Total voted budget of EUR 68.5 million in commitment appropriations, of which EUR 61.0 million for operational expenditure, EUR 3.5 million for administrative expenditure and EUR 4.0 million of unused appropriations not required in the financial year. Voted budget of EUR 44.1 million in payment appropriations, of which EUR 37.5 million for operational expenditure, EUR 4.5 million for administrative expenditure and EUR 2.1 million of unused appropriations not required in the financial year but needed to meet early 2017 payments.
Budget implementation	The Budget implementation in terms of commitment appropriations is at 100% and at 82.5% in terms of payment appropriations (in both cases, excluding the unused appropriations not required in the financial year). The lower implementation of payment appropriations in Title 2 (55.2%) is due to the use of multi-annual framework contracts. In absolute values, the Operational Budget was implemented at EUR 61.0 million in commitment appropriations and EUR 31.6 million in payment appropriations. The Administrative Budget of EUR 3.5 million in commitment appropriations and of EUR 3.1 million in payment appropriations (the difference in the value of payment appropriations vs commitment appropriations is due to contractual services becoming

	due in 2019 and afterwards, as explained related to multi-annual framework contracts).
Grants	In June 2017, the S2R JU awarded 17 grants as a result of the 2017 Call launched on 10 November 2016. The corresponding grants agreements were signed between July and October 2017 allowing the start of the first projects already in September 2017. The 2017 grants will co-fund Research and Innovation activities (for a total value of EUR 110.9 million) up to EUR 60.1 million. In this respect, it should be noted that the Founding Members other than the Union and the Associated Members (jointly referred to as the "Other Members ") agreed to limit their requests for co-funding to 44.44% of the total project cost (which result in 41.44% net of the cash contribution to the JU). The lowest in overall H2020 Programme.
Strategic Research Agenda	The S2R JU Programme is described in the Multi-Annual Action Plan (MAAP) adopted by the S2R GB in 2015. A new MAAP Executive View (Part A) has been adopted by the S2R GB on 27 October 2017.
Call implementation	On 27 Oct 2017, the S2R GB adopted the Annual Work Plan (AWP) 2018, which was amended by a S2R GB Decision of 4 Jan 2018 due to the need to further clarify the legal basis for the use of the Lump Sum Grant approach. Following the S2R Info-Day of 12 Dec 2017, on 12 January 2018, the S2R JU published the 2018 Call for proposals to progress more focused activities in the execution of the S2R R&I Programme. Information on the one call launched in 2017 is available in the following section of this document.
Participation, including SMEs	Under the 2017 Call, 120 SMEs participated to the 2017 Call (25.6%) and 50 SMEs were retained for funding (25%). In the OC part of the 2017 Call, more than 35% of the participants of funded Projects are SMEs.

EXECUTIVE SUMMARY

The Shift2Rail Joint Undertaking (S2R JU) is a public-private partnership under the Horizon 2020 Framework Programme[2] established to manage and coordinate mission-oriented Research and Innovation (R&I) activities for a major transformation in rail systems in Europe.

The S2R JU was officially established on 7 July 2014, following the adoption of Council Regulation (EU) No 642/2014 of 16 June 2014 establishing the Shift2Rail Joint Undertaking (S2R Regulation).

2017 saw the progress of the R&I activities launched in 2016. They are now well on track and largely proceeding at cruise speed. A new wave of R&I activities (Call 2017) started on 1 Sept 2017 and are in their ramp up phase. In total, it is estimated that the Total Project Cost of the activities performed in 2017 amounts to EUR 63.4 million.

During the month of April 2017 the S2R JU assessed its R&I activities through its first Control Gate assessment[3]. This first exercise took into account the deliverables and reports submitted in the context of the Annual Review of the 2015-2016 Projects coordinated by the other Members than the European Union (hereinafter Other Members). This process is integrated in the overall Programme monitoring realized through the quarterly meetings of the Innovation Programmes (IPs) where it is assessed how the different R&I activities organized in Projects are progressing in a coherent and integrated manner.

The S2R JU programme team conducted also projects review meetings during the month of March 2017.

The European Commission tasked also the S2R JU to assess the technical progress from the mid-term report of the four S2R Lighthouse Projects, stemmed from the 2014 H2020 transport call, administratively managed by DG Move (IN2Rail (LP), IT2RAIL (LP) and SMART-RAIL (LP)) and by DG RTD (ROLL2RAIL (LP)).

This Programme assessment allowed the S2R JU to confirm that overall the progress of the activities has been in line with the expectations; initial results are expected to be visible in 2018 with the presentation of some Technology Demonstrators quick-wins at InnoTrans 2018 event. The S2R JU also took some corrective measures for a correct synchronisation of the Programme, resulting in the acceptance of few deliverables submission delays that will not, in principle, affect the overall Programme results. During this process, it clearly appeared that there is not a continuous internal communication process within the Other Members' entities; the current matrix structure of the Programme does not facilitate the implementation due to the fact that often those in charge of projects do not report to those seating in the S2R GB or other key governance bodies.

In June 2017, the S2R JU awarded 17 grants as a result of the 2017 call launched in November 2016.

The corresponding grant agreements were signed between July and October 2017 allowing the start of the first projects already in September 2017. The value of the R&I activities of the 2017 Call

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[2] Council Decision (EU) No 2013/743/EU of 3 December 2013 establishing the specific programme implementing Horizon 2020 (2014-2020), OJ L 347, 20.12.2013, p. 965.

[3] Accordingly to the procedure set in the S2R Governance and Process handbook, finalised also in 2017 and 3 transparently published on the S2R website: https://shift2rail.org/wp-content/uploads/2017/12/S2RJU-Governance-and-Process-Handbook_20171010_v11_Cleanv-nd.v2.pdf

amounts to EUR 110.9 million, to be co-funded by S2R JU up to a maximum of EUR 60.1 million. As in the case of the previous years and for the full duration of the Programme, the Other Members of the S2R JU agreed to a co-funding rate of maximum 44.44% (41.44% net after the cash contribution to the S2R JU admin costs), the lowest rate in all H2020 Programme funding, demonstrating a strong commitment to deliver the most ambitious Railway R&I Programme for a major transformation to rail systems, once deployed.

469 entities, of which 120 SMEs (25.6%), participated to the 2017 Call 2017. They represented 30 States, of which 26 EU Member States and 4 Countries Associated to the Horizon 2020 Framework Programme (See Annex C for details).

During the second half of the year, S2R JU conducted a strategic review of the S2R MAAP, together with its Members, advisory groups (SRG, SC), ERA, sector stakeholders (S2R User Requirement groups (UR-ID), ERRAC, etc.) and finally a public consultation (the draft final was published on the S2R JU website). On 27 Oct 2017, the S2R GB adopted the MAAP Executive View (Part A). It outlines the S2R JU's Vision and bring the final user, passenger or freight, at the centre of the R&I work to be performed. The Innovative Solutions that will be delivered in the years to come constitute the technology and operational building blocks that will contribute to achieve "12 Innovation Capabilities" identified by the operators (rail undertakings and/or infrastructure managers within a UIC working group). S2R R&I combined together with a coordinated and integrated deployment will deliver a major railway system transformation that will be at the centre of advanced integrated mobility. The delivery approach of S2R R&I shall be starting with 2018, where at InnoTrans some quick wins will be demonstrated.

Once the work on the MAAP Executive View was completed, the Other Members in coordination with the JU continued to update the technical part of the MAAP, called now the MAAP Part B, taking stock of the first results of the ongoing Projects and of new technologies/businesses emerging. This work is expected to be finalised by mid-2018 and adopted by the S2R GB by year end at the latest.

In December 2016, the S2R JU started the process for the preparation of the 2018 Call that was finally published on 12 Jan 2018; the original version of the AWP 2018 was published on 27 Oct 2017. This lengthy process includes the key contribution of the S2R Members, the review and advice at different points of the SC, SRG, ERA and UR-ID and the adoption by the S2R GB, after the overall work was finalized under the responsibility of the Executive Director.

Since its appointment, the Executive Director was requested by the Members to ensure the streamline of the S2R Programme, starting with its administration. The Executive Director, together with the Programme Office, looked at the simplification process introduced by the European Commission through the Lump Sum Grant approach; after extensive internal discussions and analysis decided to propose to the S2R GB, as part of the AWP 2018, the adoption of the Lump Sum Grant for the CFM part of the 2018 Call, as a pilot project. This meets R&I stakeholders expectations that public international bodies in charge of mission-oriented Programmes, such as the S2R JU, be willing to experiment with both bringing in new expertise (e.g. establishing novel forms of collaboration to pool and share expert knowledge) and changing routines and processes to build dynamic organisational capabilities (including performance management, procurement, grants, etc.). The S2R JU is at the forefront of such processes in a risk management approach.

The 2018 Call was open for proposal submission until 24 Apr 2018 and consists of R&I activities for EUR 155.2 million, including:

- topics open to the S2R JU Other Members, which are expected to realize activities for EUR 134.1 million, to be co-funded up to EUR 59.6 million by the S2R JU resulting in a net contribution of EUR 74.5 million, and
- "Open Call" (OC) topics, for a total value of around EUR 21.1 million, funded by the S2R JU up to EUR 19.1 resulting in in kind activities of EUR 2.0 million (due to the Innovation Action projects which are financed up to 87.5%).

Most of the topics are strongly interrelated, providing clear opportunities for Programme openness though intertwining R&I activities from Members and non-members; some are only designed specifically for open contributions.

On 7 June 2017, the S2R GB mandated the Executive Director to establish the necessary process to allocate EUR 5.6 million of co-funding still available within the Union funding available for the Associated Members. An *Invitation to S2R JU Associated Members to submit an answer in view of the realignment of their activities and additional commitment to the S2R Programme* was published in June 2017, ensuring transparency and equal treatment. The Invitation was made public to provide the opportunities to third entities to join existing Associated Members to perform railway R&I. The Invitation results are expected to be finalised in the first quarter of 2018.

In order to provide administrative support to the Programme execution, the JU has progressed in the recruitment of staff filling budgetary open positions; at the end of the year, 20 position were filled and 3 positions were covered by interim staff while the recruitment process is in preparation. The JU is subject to high turnover mostly due to the fact that other Union JUs and Agencies are in the position to offer Temporary Agent posts (TA) instead of Contractual Agent posts (CA). In fact, contrary to almost all other Union Institutions, Agencies and JUs, the S2R JU has a Staff Establishment Plan with 25% TAs positions and 75% CAs positions; in almost all other cases, these percentages are reversed!

In 2017, the S2R JU enhanced strongly its communication and dissemination activities, starting with the participation to key European and International events (International Railway Summit, UITP Global Public Transport Summit, TRAKO International Railway Fair, TEN T Days, IPIC, ITS, etc), S2R Regional Information Days (inter alia, UK, SP, PT, EL, FR, Central Europe). In 2017, the first S2R Newsletter was published as well as its first Annual Report. The website has been redesigned to bring up the Programme, the Projects implementing it and their deliverables and results. This is only the beginning of a continuous process.

In parallel the JU improved its internal organisation to provide support to its Members and warrant sound financial management, legality and regularity of its activities through a risk management approach.

With regard to the Discharge in respect of the implementation of the Budget of the S2R JU for the financial year 2016 and the European Parliament resolution, the present report provides in its different sections the answer requested by the Budgetary Authority. All actions have been implemented without delay and reinforcing the internal control management system of the S2R JU.

It can be concluded that, thanks to the commitment of its Members together with the Programme Office, 2017 has seen the S2R JU accelerating its progress towards delivering the Programme with a clear final users focused approach.

INTRODUCTION

The S2R JU was established by Council Regulation (EU) No 642/2014 of 16 June 2014 (S2R Regulation) with, in Annexe I, the S2R Statutes.

The S2R JU is a 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. Inter alia, the S2R JU shall manage all rail-focused R&I actions co-funded by the Union.

The S2R JU is a mission-oriented Programme delivering a major system transformation, bringing railway at the centre of advanced integrated mobility.

The Vision of S2R JU is

TO DELIVER, THROUGH RAILWAY RESEARCH AND INNOVATION, THE CAPABILITIES TO BRING ABOUT THE MOST SUSTAINABLE, COST-EFFICIENT, HIGH-PERFORMING, TIME DRIVEN, DIGITAL AND COMPETITIVE CUSTOMER-CENTRED TRANSPORT MODE FOR EUROPE.

Rail R&I conducted within the S2R JU must contribute to addressing the challenges faced by the rail sector, through a comprehensive and coordinated approach to R&I focusing on the needs of the rail system and of its users, including in Member States that do not currently have a railway system within their territory.

This is part of a clear legal framework, where the European Commission, DG MOVE in particular, inter alia defines the transport and mobility policies, the S2R JU contributes to delivering and challenging them through its R&I Programme and ERA acts within its regulatory mandate under the 4th Railway Package.

In addition to the Union, the S2R JU has eight Founding Members other than the Union[4] and nineteen Associated Members. The latter were selected following a call for expression of interest to become Associated Member of the S2R JU[5] [6].

In this respect, its main objective is to implement the S2R Programme, R&I activities in the railway sector in Europe, through the collaboration between stakeholders in the entire railway value chain, also outside the traditional rail sector, with particular attention to SMEs, research and technology centres and universities.

The Union tasked the S2R JU with its Regulation and Statutes, *to manage all rail- focused research and innovation actions co-funded by the Union, ensuring coordination among projects and providing all stakeholders with relevant and available information on projects funded across Europe*.

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[4] Consisting of rail equipment manufacturers Alstom Transport, Ansaldo STS, Bombardier Transportation, Construcciones y Auxiliar de Ferrocarriles (CAF), Siemens AG, Thales and infrastructure managers Trafikverket and Network Rail

[5] Commission Decision N° C(2014) 7084 final

[6] AERFITEC consortium, Amadeus IT Group SA, AZD Praha s.r.o., CFW consortium, Deutsche Bahn AG, DIGINEXT, EUROC consortium, Faiveley Transport, HaCon Ingenieurgesellschaft mbH, Indra Sistemas S.A., Kapsch CarrierCom, Knorr-Bremse GmbH, MER MEC S.p.A., Patentes Talgo S.L., Railenium Swi'TRACK'EN consortium, Smart DeMain consortium, SmartRaCon consortium, SNCF, Virtual Vehicle Austria consortium+

This task is complemented by the request of the Union to the S2R JU *to establish and develop — and ensure the effective and efficient implementation of — a strategic Master Plan (the 'S2R Master Plan')*, which has been endorsed by the Council[7], and which provides a high-level view of what needs to be done; it explains why and by when. It sets the framework for the research and innovation (R&I) activities to be performed within and beyond the S2R Programme and the deployment activities to be carried out by all operational stakeholders, coordinated to achieve the Single European Railway Area.

S2R has developed, together with its Members and advisory bodies, the S2R MAAP, which translates the S2R Master Plan into detailed, result-oriented R&I activities to be performed to start delivering the S2R partnership vision as from 2014 onwards. The S2R MAAP contains two parts: an Executive View developed in 2017[8] and a technical part which is currently under revision[9]. Overall, the S2R JU shall:

- contribute to the implementation of H2020 Regulation and in particular part of the Smart, Green and Integrated Transport Challenge under the Societal Challenges pillar of Decision No 2013/743/EU;
- contribute to the achievement of the Single European Railway Area, to a faster and less costly transition to a more attractive, user-friendly (including for persons with reduced mobility), competitive, efficient and sustainable European rail system, and to the development of a strong and globally competitive European rail industry;
- play a major role in rail-related R&I, ensuring coordination among projects within its overall Programme. It provides all stakeholders with relevant and available information on R&I activities funded across Europe. It shall also manage all rail-focused R&I actions co-funded by the Union;
- actively promote the participation and close involvement of all relevant stakeholders from the full rail value chain and from outside the traditional rail industry. In particular, it fosters the involvement of small and medium sized enterprises (SMEs), as defined in Commission Recommendation 2003/361/EC (8);
- develop demonstration projects in interested Member States including those that do not currently have a railway system established within their territory.

The S2R Joint Undertaking shall, more specifically, seek to develop, integrate, demonstrate, and validate innovative technologies and solutions that uphold the strictest safety and security standards and the value of which can be measured against, inter alia, the following key performance indicators:

- a 50 % reduction of the life-cycle cost of the railway transport system, through a reduction of the costs of developing, maintaining, operating and renewing infrastructure and rolling stock, as well as through increased energy efficiency;
- a 100 % increase in the capacity of the railway transport system, to meet increased demand for passenger and freight railway services;
- a 50 % increase in the reliability and punctuality of rail services (measured as a 50 % decrease in unreliability and late arrivals);
- the removal of remaining technical obstacles holding back the rail sector in terms of interoperability, product implementation and efficiency, in particular by endeavouring to close points which remain open in Technical Specifications for Interoperability (TSIs) due to lack of technological solutions and by ensuring that all relevant systems and solutions

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[7]   http://ec.europa.eu/transport/modes/rail/doc/2015-03-31-decisionn4-2015-adoption-s2r-masterplan.pdf
[8]   https://shift2rail.org/wp-content/uploads/2017/11/Shift2Rail-MAAP-Part-A_Executive-View_webfinal.pdf
[9]   http://www.shift2rail.org/wp-content/uploads/2013/07/S2R-JU-GB_Decision-N-15-2015-MAAP.pdf

developed by the S2R Joint Undertaking are fully interoperable and fitted, where appropriate, for upgrading;

- the reduction of negative externalities linked to railway transport, in particular noise, vibrations, emissions and other environmental impacts.

R&I activities are performed by the Other Members and any other eligible entity. They are co-funded or procured by the S2R JU in accordance with its budget availabilities and in compliance with the H2020 Regulation[10], its Rules of participation[11] and the S2R Financial Rules. To this end, the S2R JU shall organise calls for proposals and/or for tenders for supporting the R&I activities.

As specified in Article 17 of the S2R Statutes,
- a. up to 40% of the Union financial contribution to the S2R JU operational budget shall be allocated to the R&I activities performed by its Founding Members other than the Union and their affiliated entities,
- b. 30% shall be allocated to the Associated Members and their affiliated entities
- c. a minimum of 30% through open and competitive calls .

As for the "open and competitive calls" (point c. here above), also the award of the R&I activities to the Other Members (a. and b. here above) is through competitive calls in compliance with H2020 Rules of Participation and/or calls for tenders, under the relevant eligibility criteria.

1.   IMPLEMENTATION OF THE ANNUAL WORK PLAN 2017

1.1.   Key objectives 2017 and associated risks

In 2017, the S2R JU activities were driven by the overarching objective to progress the S2R R&I Programme according to the MAAP and detailed in the AWP 2017.

The main operational achievements in 2017 can be summarized as follows:

Delivery of Programme R&I activities

During 2017, the Other Members and the OC Projects continued the implementation of the S2R Programme through 44 Projects and some procurement contracts, awarded since 2016, for an estimated R&I Total Value of EUR 63.4 million. Details are provided in Section 1.7.

In addition the Programme supervision and monitoring was implemented through specific 17 Control Gates (project reviews, 13 CFM projects and 4 lighthouse projects) executed all along the year, the direct organisation of some CCA activities on KPIs and Standards in particular, the establishment of a Governance and Process Handbook, the review of the MAAP, the management of 6 quarterly IP Steering Committees and the follow up of the grant implementation (amendments, reporting, etc).

Signature of grants related to the 2017 Call for proposals

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[10]   http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:347:0104:0173:EN:PDF
[11]   http://ec.europa.eu/research/participants/data/ref/h2020/legal_basis/rules_participation/h2020-rules-participation_en.pdf

During 2017, the S2R JU awarded and signed grants for a Total value of EUR 110.9 million

- topics (RIA and IA) open to S2R JU Other Members with a total value of the actions of EUR 91.4 million (max S2R co-funding EUR 40.6 million);
- topics (RIA) where the S2R JU Members are excluded from participation, with a total value of the actions of EUR 19.5 million (100% funded).

2017 Call for tenders

- signature of the contract for the Human Factor tender in Dec 2017 for an amount of EUR 0.2 million;

- launch of the call for tenders "*Pantograph – Overhead Contact Line Interaction – Dynamic Behaviour and Quality of the Current Collection*", where the S2R JU Other Members are excluded from participation, with a maximum value of EUR 0.7 million. The contract was awarded in 2018.

Stakeholder management and external relations have been further improved through a closer collaboration with the European Union Agency for Railways (ERA) in different areas, as well as with the different International and European organizations and associations.

Communication has been enhanced through the participation in specific activities, workshops and events in order to promote the S2R Programme participation and inform worldwide the achievements of the S2R JU Partnership.

The achievement of the JU operational objectives contributed to finalise the ramp up phase allowing the Programme to proceed at cruise speed with an effective stakeholder engagement.

The following sections describe how these objectives have been achieved, the activities performed and the resources used. In Annex C the performances are measured against the set of agreed KPIs.

Risks

The list below refers to the risks related to the set objectives and is the result of Risk Management activities performed in 2017. Only risks that because of their criticality require continuous ED and where relevant S2R GB, attention and treatment are reported here together with the ongoing and proposed mitigating actions.

Risk identified	Action Plan
Adequacy of the MAAP to the evolving needs of the users and stakeholders' expectations	During 2017, a revised version of Part 1 and 2 of the MAAP (now called Part A) has been finalized and Part 3 (now call Part B) maintained taking into consideration the new top down approach.
In accordance with the H2020 Rules of Participations and considering the resources available on a yearly basis, the Programme shall be implemented through Projects financed by annual grants. Largely, this may result in a piecemeal approach instead of innovative solutions towards a new railway integrated, connected and automated system. This may	Qualitative mitigating measures are identified and implemented to contain and monitor the identified risks. This is realised through the S2R GB, SIWG and IP SteCos which maintain a Programme view compared to a piecemeal project view. During 2017, the sound financial management risks has been further assessed and possible adequate measures implemented

Risk identified	Action Plan
result on questioning the sound financial management of the implementation process through grants, especially with regards to Members selected through open competition and commitment.	accordingly. These are measure that can only mitigate the complexity of a matrix Programme that should have been simpler by design.
Delays or inadequacies in the completion of activities in grants that are complementary or prerequisites to grants to be awarded under the AWP 2018 may result in an inability to implement activities under AWP 2018.	Ensure, through program management, regular activity the monitoring and reporting of projects, including gate reviews to determine whether specific actions need to be taken with regard to a specific project (re-orientation, early closure, etc.). As from 2018, a process to assess what to bring at higher TRLs and especially to demonstrators level shall be developed.
Cross projects collaboration to achieve the programme objectives at risk because of "silos" projects or IP approaches	Developing specific working groups per thematic areas where IPs are involved and ensure coherence between projects activities + decoupling IP structure from AWP topics + further fostering use of common S2R Cooperation Tool and sharing functionalities
S2R JU members fail to deliver on additional activities.	Additional activities plan is contained in the membership agreement. Work with the members on preparation and implementation of the certification and reporting requirements. This risk will be deleted in 2018 as the target will be reached.
Lack of adequate dissemination of result may develop in vague information to the end-user/interested parties and could compromise the JU impact.	The JU is working towards a joint dissemination plan, monitoring the dissemination actions and promoting project results. In addition, the S2R JU has taken actions to enlarge the participation to its call through its SRG in view of the establishment of Memoranda of Cooperation including to ensure the blending of resources for R&I and the future deployment of S2R Innovative Solutions.[12]
There is a risk of the projects underspending the resources available.	Together with the Other Members, the JU has put in place a reporting and monitoring systems that should detect any risk of underspending and take the necessary corrective measures.
TDs not/partially achieved because of: - lack of resources (staff, money, assets etc.) - Members priorities/merge/stepping out - insufficient or late delivery/input from the projects	Proper planning and regular follow up at IPSteCo/SIWG + Projects control gates + regular reporting to S2R GB.
Demonstrations non interoperable because representing a single company solution	Collaborative approach in GA + Projects control gates + regular reporting to S2R GB.
Projects development not aligned with S2R	Programme perspective in GA + regular follow

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[12] Also in answer to point 22 of Discharge 2016 of EP, reference P8_TA-PROV(2018)0173.

Risk identified	Action Plan
Programme	up at IPSteCo/SIWG + regular reporting to S2R GB.
Operational demonstrations not/partially achieved because of difficulties in obtaining Authorisation(s)	Planning anticipation and regular follow up at IPSteCo/SIWG + ERA involvement + regular reporting to S2R GB.
S2R solutions not reaching the market due to lack of coordination and resources at deployment level	investigate possible instrument to support deployment at EU level and implement JU strategy/support
Partial or limited stakeholders (including Members) acceptance of S2R solutions	decision made on consensus based approach in IP SteCo/SIWG/S2R GB + involvement of URID-WG (how the S2R solutions are accepted - develop strategy)
Significant cut in EU budget	The JU Membership shall put in place all the measures to provide all the elements to the budget authority to reduce such a risk
Governance: organisation complexity that impacts S2R JU global objectives	On the one hand, the S2R JU shall focus on delivering the Programme results and, on the other hand, assess and put in place measures that can make its governance more effective and efficient. Introduction of the Lump Sum Grant pilot.
Turnover of staff and Insufficient number and/or qualitative of applications due contract conditions	Within the budget constraints prepare a career plan for staff. Ensure business continuity
Lack of back-up for JU key function	Replacement plan (back-up) where possible including through external support (interim, expert, outsourcing)

1.2.   R&I activities: the S2R Programme

The S2R MAAP translates the S2R Master Plan into detailed, result-oriented R&I activities to be performed to start delivering the S2R vision as from 2016 onwards.

Addressing the challenges opens three opportunities for the railway:

- To become the backbone of current and future mobility concepts (e.g. mobility as a service-MaaS) and on-demand future logistics;
- To identify and establish new market segments for exploitation;
- To enhance the overall competitiveness of the industry, both in Europe and globally.

This is what the Regulation tasks the S2R JU to do when requesting it to manage all rail-focused research and innovation actions co-funded by the Union. Developing the Innovation Capabilities requires a coordinated effort among different rail and non-rail stakeholders to drive innovation at levels in Europe. The S2R JU and its Programme are designed to make a decisive contribution to delivering the essential knowledge and innovation that will provide the building blocks to develop the Innovation Capabilities.

The work conducted within the S2R framework is structured around five asset-specific Innovation Programmes (IPs), covering the different structural (technical) and functional (process) sub-systems

of the rail system. These five IPs are supported by work in five cross-cutting areas (CCA) covering themes that are of relevance to each of the projects and which address the interactions between the IPs and the different subsystems:

- IP1: Cost-efficient and Reliable Trains, including high-capacity trains and high-speed trains
- IP2: Advanced Traffic Management & Control Systems
- IP3: Cost-efficient, Sustainable and Reliable High-Capacity Infrastructure
- IP4: IT Solutions for Attractive Railway Services
- IP5: Technologies for Sustainable & Attractive European Freight.
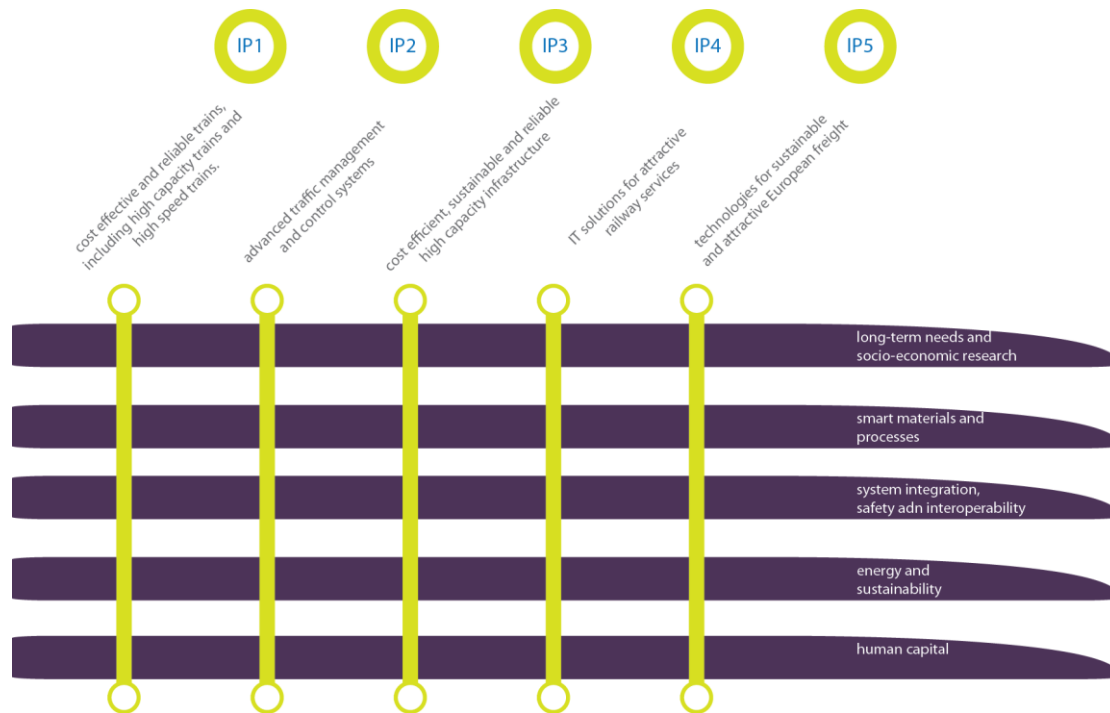
With a holistic approach, the role of the S2R JU is also to ensure that interactions between the various IPs are adequately considered and managed, as technological developments in one part of the system could lead to changes in performance, or even create barriers, in other parts. In addition, cross cutting activities include research on long-term economic and societal trends such as customer needs and human capital and skills, which must be taken into account by the different IPs.

Different types of activities contribute to the Programme development, including:

- studies, fundamental and "blue-sky" research (TRL 0 – 2),
- scientific/applied research and laboratory demonstrations (TRL 3 – 6)
- operational demonstrations and innovation activities (TRL 6-7)
- other supporting activities.

In addition to these activities that are co-funded by the S2R JU and conducted within the scope of the S2R Programme, the Other Members are required to conduct Additional Activities with a view to leveraging the effect of the overall R&I. These Additional Activities are not eligible for financial support from the S2R JU but must contribute directly to the broader objectives set out in the Master Plan.

1.3. Call for proposals and grant information

Considering the annual budget availabilities and the R&I activities planned in the S2R MAAP, the S2R Programme is implemented through combined and interdependent multi-annual Projects. This structured interdependence of S2R Projects reflects the Technological Demonstrators (TD) and Work Areas (WA) approach set within the Programme and each IP and CCA.

The following table summarises the amounts and topics available under the 2017 Call, against Budget Commitments of 2017. This Call was launched in November 2016 and awarded by the JU following the Decision of the S2R GB of 7 June 2017[13]. It is presented showing the values of the topics open to Other Members (CFM) and those excluding them (OC).

Call	Type	Estimated S2R JU funding	Number of topics
H2020-S2RJU-2017-01	CFM	41.3 M€	7
	OC	19.5 M€	10

The total number of proposals received in response to the call for proposals was 61:

Call	Type	Number of proposals	Number of topics
H2020-S2RJU-2017-01	CFM	8	7
	OC	53	10

The total S2R JU contribution requested by all the submitted proposals amounted to EUR 136.4 million compared to EUR 59.8 million available for funding:

Call	Type	Requested S2R JU funding	Estimated S2R JU funding available
H2020-S2RJU-2017-01	CFM	40.6M€	41.3 M€
	OC	95.8 M€	19.5 M€

On 7 June, the S2R GB agreed with the proposal of the ED to award grants for the following:

Call	Type	Total Project Cost	S2R co-funding	IKOP
H2020-S2RJU-2017-01	CFM	91.4 M€	40.6 M€	50.8 M€
	OC	19.5 M€	19.5 M€	00.0 M€
	TOTAL	**110.9 M€**	**60.1 M€**	**50.8 M€**

The S2R JU Other Members submitted project proposals to cover all the 7 call topics open to them.

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[13] Governing Board Decision N° 01/2017 of 07 June 2017 https://shift2rail.org/wp-content/uploads/2017/09/Decision-1_2017-List-of-actions-under-call-H2020-S2R-JU-2017-1_signed.pdf

The value of activities to be performed by the S2R JU Other Members in the coming years in respect of this call amounts to EUR 91.4 million that will be co-funded by the S2R JU up to EUR 40.6 million. These projects, which started on the 1 September 2017, are well on their ramp up phase.

Considering the project awarded in 2016, the overall value of Other Members ongoing projects is EUR 233.8 million which are expected to be co-funded by the S2R JU up to EUR 103.9 million.

The applicants to the OC covered the 10 topics open to them. The value of the activities to be performed by the awarded consortia amounts to EUR 19.5 million and will be financed by the S2R JU up to 100% of the eligible direct costs. The overall OC amount of ongoing projects, including 2016 Call and tenders, is EUR 44.5 million

The S2R GB at its meeting on 7 June 2017 approved the list of actions selected for funding proposed by the Executive Director; evaluation result letters were sent to all applicants on 17 June 2017.

With regard to two Projects awarded as result of the Calls 2015 and 2016 where two coordinators were reported with "weak" financial viability, it should be noted that the two entities are S2R JU Members which went through an assessment process performed by the Commission Services – before the existence and/or autonomy of the S2R JU – which did not bring up any financial weakness which would put under question the capacity of these entities to deliver the S2R Programme up to 2024. In addition it should be noted the following:

- for one of them, the weak financial analysis performed by REA services appeared to be uploaded in SyGma/Compass on 4/08/2016 after the date of AO signature. In addition, the financial analysis was done on a single entity of a global Group without having a consolidated level. The 2016/2017 financial outlook shows positive results at group level and the rating by Moody's is stable at long-term;

  Consequently, although the crossing of the new financial assessment by REA and the signature of the Authorizing Officer crossed each other, without the possibility for the Authorizing Officer to react before signature. taking into account the performance of the worldwide activities by the concerned entity and the group financial strengths it is reconfirmed that the signature of the Authorizing Officer is in line with the principle of sound financial management. S2R brought up the question also with REA.

- with regard to the second entity, for the reasons already mentioned here above (a S2R JU Member), the AO took accountability to go ahead with the signature of the GA and exchanged with the Financial Team on the need for a specific follow up of the evolution of the situation. In this respect and in accordance with the relevant H2020 rules, the S2R JU documented the following comments on the projects with the concerned entity as coordinator: "*the entity was given a "weak" qualification on the financial data Y 2015 in particular in "More-in-depth" indicator, mainly on poor profitability ratios. The S2R JU looked in detail the evolution of the entity during the recent years and, after due consideration, decided to keep the coordinator and perform increased monitoring on financial capacity on yearly basis. This decision is motivated by good solvency standing of the company and acceptable quick ratio.*"

In both cases, the S2R JU established an internal procedure to explain the measures related to reinforced monitoring and follow-up. This reinforced monitoring starts with the bilateral meeting the ED and the Programme Office has with the Senior Management of the S2R JU Members, to follow up their evolution at strategic, financial and operational level in order to ensure the proper delivery of the S2R Programme. In addition, reinforced monitoring will be implemented at Project level through the Control Gate.

During 2017, it is confirmed that neither entities nor the projects they are coordinated were affected in any manner by this "weak" qualification whose value and approach appear questionable.

Call topics open to S2R JU Other Members and Awarded projects

TOPIC	ACRONYM	TITLE	PROJECT VALUE	GRANT	INKIND.CONTR.	START DATE	END DATE
S2R-CFM-IP4-02-2017	COHESIVE	Coherent set up and demonstration of integrated travel service	4.0	1.8	2.2	01/09/2017	30/06/2022
S2R-CFM-IP2-01-2017	X2RAIL-2	Enhancing railway signalling systems based on train satellite positioning, on-board safe train integrity, formal methods approach and standard interfaces, enhancing Traffic Management System functions	30.2	13.4	16.8	01/09/2017	31/08/2020
S2R-CFM-IP3-01-2017	IN2STEMPO	Innovative Solutions in Future Stations, Energy Metering and Power Supply	13.4	6.0	7.4	01/09/2017	31/08/2022
S2R-CFM-IP1-01-2017	PIVOT	Performance Improvement for Vehicles on Track	18.9	8.4	10.5	01/10/2017	30/09/2019
S2R-CFM-IP5-01-2017	FR8HUB	Real-time information applications and energy efficient solutions for rail freight	9.9	4.4	5.5	01/09/2017	31/08/2020
S2R-CFM-CCA-01-2017	IMPACT-2	Indicator Monitoring for a new railway PAradigm in seamlessly integrated Cross modal Transport chains – Phase 2	7.1	3.1	4.0	01/09/2017	31/08/2022
S2R-CFM-IP4-01-2017	CONNECTIVE	Connecting and Analysing the Digital Transport Ecosystem	7.9	3.5	4.4	01/09/2017	30/06/2022
TOTAL			**91.4**	**40.6**	**50.8**		

Open call topics for S2R JU non-Members and awarded projects

TOPIC	ACRONYM	TITLE	PROJECT VALUE	GRANT	START DATE	END DATE
S2R-OC- IP3-03-2017	MOMIT	Satellite and autonomous monitoring systems' solution	0.6	0.6	01/09/2017	31/08/2019
S2R-OC- IP1-01-2017	Mat4Rail	Innovative materials & modular design for rolling stock applications	3.5	3.5	01/10/2017	30/09/2019
S2R-OC- IP2-02-2017	ETALON	Energy harvesting methodologies for trackside and on-board signalling and communication devices. Adaptation of already existing technologies for developing a purely on-board Train Integrity	1.7	1.7	01/09/2017	31/01/2020
S2R-OC- IP1-02-2017	RUN2Rail	Tools, methodologies and technological development of the next generation of Running Gear	2.7	2.7	01/09/2017	31/08/2019
S2R-OC- IP3-01-2017	IN2DREAMS	Smart metering and asset management of railway systems	2.2	2.2	01/09/2017	31/08/2019

TOPIC	ACRONYM	TITLE	PROJECT VALUE	GRANT	START DATE	END DATE
S2R-OC- IP2-02-2017	ASTRail	Operational conditions of the signalling and automation systems; signalling system hazard analysis and GNSS SIS characterization along with Formal Method application in railway field	1.8	1.8	01/09/2017	31/08/2019
S2R-OC- CCA-01-2017	SMaRTE	Smart Maintenance and the Rail Traveller Experience	0.8	0.8	01/09/2017	31/08/2019
S2R-OC- IP5-01-2017	OPTIYARD	Optimised Real-time Yard and Network Management	1.5	1.5	01/10/2017	30/09/2019
S2R-OC- IP3-02-2017	FAIR Stations	Future stations and accessibility (IP1 and IP3)	1.2	1.2	01/09/2017	31/08/2019
S2R-OC- IP4-01-2017	My-TRAC	Smart technologies for improved travel companion and trip tracking	3.5	3.5	01/09/2017	31/08/2020
TOTAL			19.5	19.5		

For the Other Members' projects, the respective grant agreements were signed in August 2017 and all the activities started on 1 September 2017. The last project from the open call started activities on 1 October 2017.

1.4.   Progress against KPIs / Statistics (Annex C)

The Key performance Indicator results for the year 2017 are presented in Annex C. The JU has taken into its scoreboard all H2020 indicators, which have been established for the entire Research family by the Commission, to the extent they are applicable to the JU and provide meaningful results.

Comments to some individual indicators are provided in the table in the Annex or in the related section of the report, to which the indicators refer. In addition, the S2R JU is presenting more detailed results of its performance monitoring in specific areas, e.g. key figures provided in the section dealing with the call for proposals and the following evaluation process.

Within the context of the CCA activities, during 2017 the S2R JU, with the support of external provider made available to the Other Members working within the project IMPACT, started the development of a KPI model to measure the contribution of the R&I activities to its Regulation objectives. This work will be finalized by mid-2018 with the first release of the S2R KPI model to be embedded in the AWP2019 and AAR2018. Hence, it is expected that next year the progress of the Programme will be reported against the S2R KPI model too.

1.5.   Evaluation: procedures and global evaluation outcome, redress, statistics

The evaluation process took place in April and May 2017. The proposals were evaluated by 25 external experts, divided in five different panels, with a dedicated rapporteur for each panel. A member of the JU Programme Office acted as moderator in each panel. During the consensus meetings, an independent observer monitored the whole process. The total number of proposal evaluated was 61, and 17 were retained for funding with a success rate of 27.9%. The number of

participants in the evaluated proposals was 469, represented by 59 female and 410 male. 200 participants were retained for funding with a success rate of 42.6%. Out of the retained participants in terms of co-signatory of proposals, 30 were female (success rate 51%) and 170 were male (success rate 41%). No data are available on the composition of the R&I team at this stage.
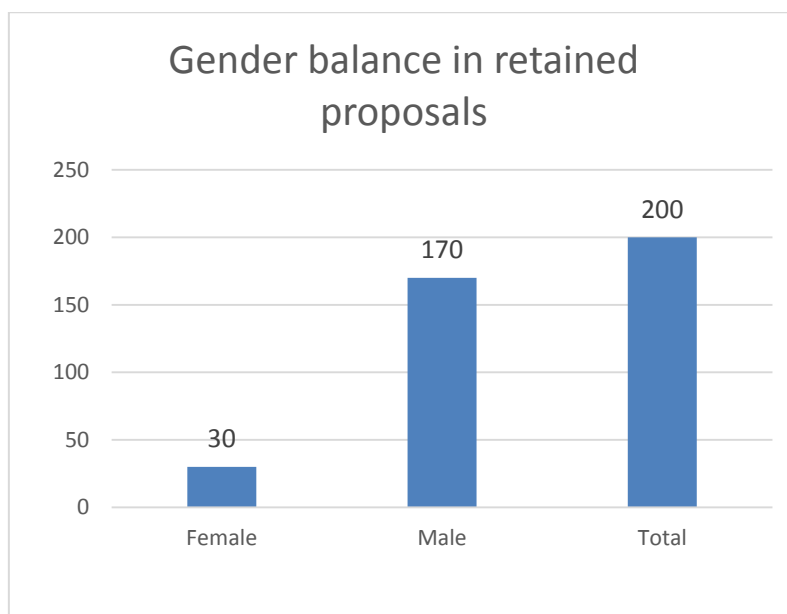
SMEs participating were 120 and 50 were retained for funding, with a very positive success rate of 41.7%. SMEs represent respectively the 25.6% and the 25% of total and retained participants for funding. In the OC topics only, more than 35.4% of the participants of funded Projects are SMEs.

From a geographical perspective, 30 Countries participated to the call, 26 were from the UE and 4 from Associated Countries. After the evaluation, the participating Countries to the retained project for funding were 16 of which 14 from EU and 2 from Associated Countries. (See details in ANNEX C)

1.6.   Activities carried out in Grant Agreements

In May 2015, while the S2R JU was still in its setup phase, under the Horizon 2020 Transport Programme and its call 2014, EUR 52 million were awarded by the European Commission to the so-called four "S2R Lighthouse Projects", lightening the way towards the Innovation Programmes at the heart of Shift2Rail. One project, ROLL2RAIL (LP), was closed in October 2017 and is currently under final technical and financial evaluation.

Project Acronym	Topic from H2020 Call 2014	Linked IP / CCA	Grant (€) million	Start date	Duration	Management[14]
IN2RAIL	MG-2.1	IP3, CCA (IP2)	18.0	01/05/2015	36	DG MOVE
IT2RAIL	MG-2.2	IP4	12.0	01/05/2015	36	DG MOVE
ROLL2RAIL	MG-2.3	IP1, CCA	16.0	01/05/2015	30	

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[14]   The overall management is performed by DG MOVE and DG RTD respectively, while the S2R JU performing a technical   oversight and ensuring consistencies between the lighthouse projects and the projects stemming from the S2R calls

Project Acronym	Topic from H2020 Call 2014	Linked IP / CCA	Grant (€) million	Start date	Duration	Management [14]
		(IP2)				DG RTD
Smart-Rail	MG-2.2	IP5	6.0	01/05/2015	36	DG MOVE
TOTAL			52.0			

The collaboration between the project Coordinators of the S2R Lighthouse projects and the members of the IP Steering Committees should allow the transfer and the use of the results by S2R Members Projects. Today the four projects appear to be fully integrated within the S2R Programme. Where there would be any issue on use of results, the S2R JU will make use of the grant provisions in terms of access rights of the Union to the results of the projects for research and policy purposes.

Beside the Lighthouse Projects, by the end of 2017, 44 projects were ongoing (20 CFM and and 24 OC); 35 projects were distributed on the 5 Innovation Programmes, and 9 projects on the Cross Cutting Activities as follow:

IP1: Cost-efficient and Reliable Trains, including high-capacity trains and high-speed trains

Project Title	Call Reference	Period	Project Value
CONNECTA	S2R-CFM-IP1-02-2016	01/09/2016 - 31/08/2018	€ 13 291 983
PINTA	S2R-CFM-IP1-01-2016	01/09/2016 - 30/11/2018	€ 29 201 993
PIVOT	S2R-CFM-IP1-01-2017	01/10/2017 - 30/09/2019	€ 18 901 890
Mat4Rail	S2R-OC-IP1-01-2017	01/10/2017 - 30/09/2019	€ 3 500 000
RUN2RAIL	S2R-OC-IP1-02-2017	01/09/2017 - 31/08/2019	€ 2 732 463
SAFE4RAIL	S2R-OC-IP1-02-2016	01/10/2016 - 30/09/2018	€ 6 681 211

IP2: Advanced Traffic Management & Control System

Project Title	Call Reference	Period	Project Value
X2Rail-1	S2R-CFM-IP2-01-2015	01/09/2016 - 31/08/2019	€ 45 003 870
X2Rail-2	S2R-CFM-IP2-01-2017	01/09/2017 - 31/08/2020	€ 30 152 828
ASTRAIL	H2020-S2RJU-OC-2017	01/09/2017 - 31/08/2019	€ 1 797 307
CYRail	S2R-OC-IP2-01-2015	01/10/2016 - 30/09/2018	€ 1 498 150
ETALON	S2R-OC-IP2-02-2017	01/09/2017 - 31/01/2020	€ 1 699 998
MISTRAL	S2R-OC-IP2-03-2015	01/11/2016 - 31/10/2018	€ 499 282
VITE	S2R-OC-IP2-02-2015	01/11/2016 - 31/10/2018	€ 1 008 826

IP3: Cost-efficient, Sustainable and Reliable High-Capacity Infrastructure

Project Title	Call Reference	Period	Project Value
IN2SMART	S2R-CFM-IP3-02-2016	01/09/2016 - 31/08/2019	€ 16 405 562
In2Stempo	S2R-CFM-IP3-01-2017	01/09/2017 - 31/08/2022	€ 13 439 981
In2Track	S2R-CFM-IP3-01-2016	01/09/2016 - 28/02/2019	€ 6 366 942
Fair Stations	H2020-S2RJU-OC-2017	01/09/2017 - 31/08/2019	€ 1 199 875
IN2DREAMS	H2020-S2RJU-OC-2017	01/09/2017 - 31/08/2019	€ 2 195 715
S-CODE	S2R-OC-IP3-01-2016	01/11/2016 - 31/10/2019	€ 4 999 771
MOMIT	H2020-S2RJU-OC-2017	01/09/2017 - 31/08/2019	€ 599 172

IP4: It Solution for Attractive Railways Services

Project Title	Call Reference	Period	Project Value

ATTRACKTIVE	S2R-CFM-IP4-02-2015	01/09/2016 - 31/12/2018	€ 5 059 579
CO-ACTIVE	S2R-CFM-IP4-01-2015	01/09/2016 - 31/12/2018	€ 7 818 365
COHESIVE	S2R-CFM-IP4-02-2017	01/09/2017 - 30/06/2022	€ 4 039 419
CONNECTIVE	SR2-CFM-IP4-01-2017	01/09/2017 - 30/06/2022	€ 7 906 243
GoF4R	S2R-OC-IP4-01-2016	01/11/2016 - 31/10/2018	€ 2 000 000
My-TRAC	S2R-OC-IP4-01-2017	01/09/2017 - 31/08/2020	€ 3 494 476
ST4RT	S2R-OC-IP4-02-2016	01/11/2016 - 31/10/2018	€ 1 000 000

IP5: Technologies for Sustainable & Attractive European Freight

Project Title	Call Reference	Period	Project Value
ARCC	S2R-CFM-IP5-02-2015	01/09/2016 - 31/08/2019	€ 3 600 360
FFL4E	S2R-CFM-IP5-03-2015	01/09/2016 - 31/08/2019	€ 3 375 017
FR8HUB	S2R-CFM-IP5-01-2017	01/09/2017 - 31/08/2020	€ 9 900 990
FR8RAIL	S2R-CFM-IP5-01-2015	01/09/2016 - 31/08/2019	€ 7 826 783
DYNAFREIGHT	S2R-OC-IP5-02-2015	01/11/2016 - 30/06/2018	€ 999 822
INNOWAG	S2R-OC-IP5-03-2015	01/11/2016- 30/04/2019	€ 1 500 562
OptiYard	S2R-OC-IP5-01-2017	01/10/2017 - 30/09/2019	€ 1 499 900
SMART	S2R-OC-IP5-01-2015	01/10/2016 - 30/09/2019	€ 999 598

CCA: Cross Cutting Activities

Project Title	Call Reference	Period	Project Value
FINE1	S2R-CFM-CCA-02-2015	01/09/2016 - 31/08/2019	€ 3 017 281
IMPACT-1	S2R-CFM-CCA-01-2015	01/09/2016 - 28/02/2018	€ 674 958
IMPACT-2	S2R-CFM-CCA-01-2017	01/09/2017 - 30/08/2022	€ 7 096 428
PLASA	S2R-CFM-CCA-03-2015	01/09/2016 - 31/08/2018	€ 786 349
DESTINATE	S2R-OC-CCA-03-2015	01/11/2016 - 31/10/2018	€ 1 271 812
GoSAFERAIL	S2R-OC-CCA-04-2015	01/10/2016 - 30/09/2019	€ 1 298 750
NEAR2050	S2R-OC-CCA-01-2015	01/10/2016 - 31/03/2018	€ 399 891
OPEUS	S2R-OC-CCA-02-2015	01/11/2016 - 30/04/2019	€ 797 130
SMaRTE	S2R-OC-CCA-01-2017	01/09/2017 - 31/08/2019	€ 769 958

The practical demonstration of S2R R&I activities is being carried out using a combination of single technology demonstrators (TDs), integrated technology demonstrators (ITDs and resulting into the Innovation Capabilities) and system platform demonstrators (SPDs)..

Technology Demonstrator (TDs)
Projects specifying, developing and demonstrating a specific technology resulting in a lab tested and/or simulated prototype

Integrated Technology Demonstrators (ITDs)
Projects integrating/combining TD prototypes at system level (lab and on-site) and testing performance

System Platform Demonstrators (SPDs)
Assessment of the whole systems performance based on the results of TDs and ITDs. SPDs bring S2R innovative solutions to a technology maturity level for a new generation of railway system

RAILWAY SYSTEM OF THE FUTURE

The following sections illustrate the progress achieved in the Technology Demonstrators at the end of 2017.

1.7. Towards delivering the S2R Programme

This section presents by Innovation Program the progress of ongoing projects implementing the R&I activities measured through the achievements in the development of Technology Demonstrators

1.7.1. IP1 Cost-efficient and Reliable Trains, including high-capacity trains and high speed trains

The pictures below gives a visual perception on where the TDs will introduce improvements
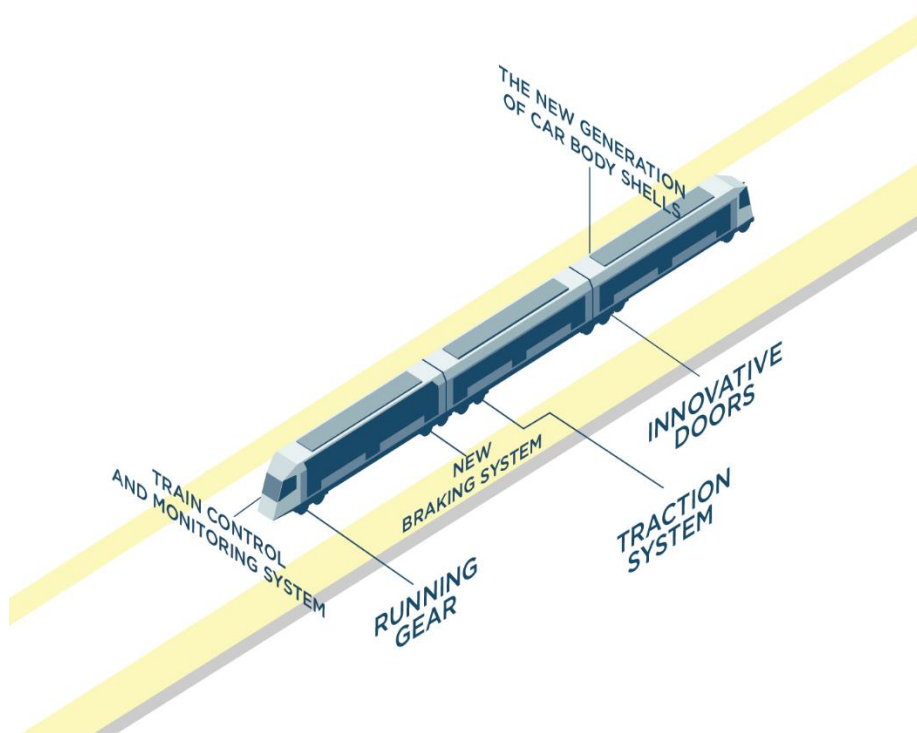
IP1 will lead to a new generation of passenger trains, lighter, automated, more energy and cost efficient while satisfying customers' needs.

The picture below shows the TDs connections and dependencies within IP1 and with other IPs and CCA.
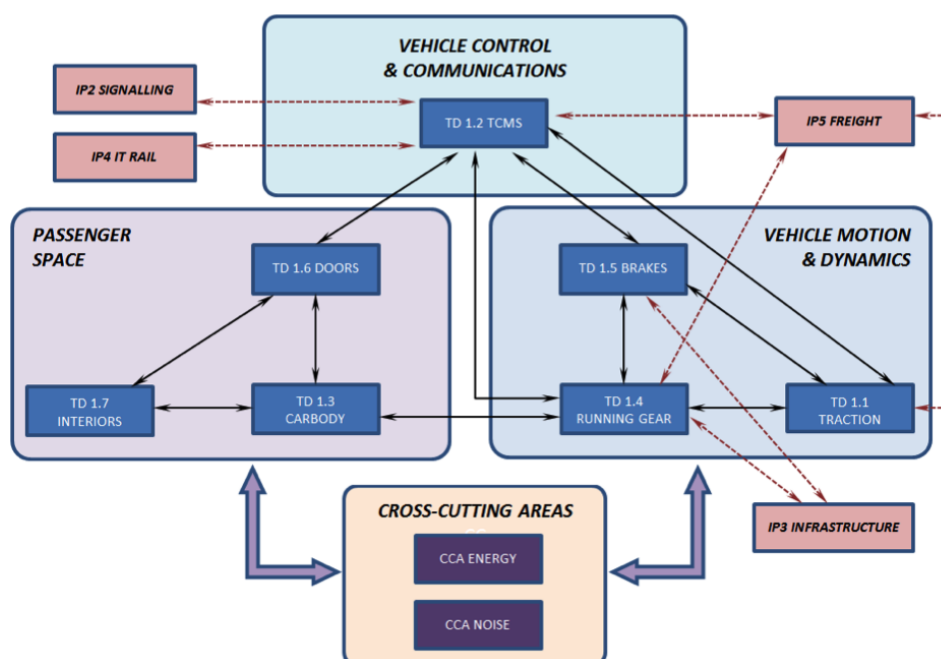
TD 1.1. Traction systems Demonstrator

The TD develops new traction components and subsystems using mainly silicon carbide (SiC) technologies leading to new architectures. The work aims at producing Technology Demonstrators (including a traction system based on independently rotating wheels) to implement into a Metro, a Regional train and a High-Speed Train. The SiC application opens up many new opportunities improvements in this key technology area. Besides improved energy efficiency, it gives other optimisation possibilities improving customer value, such as noise reduction and more efficient cooling.

TD progress

TD1.1 builds on the progress made by the ROLL2RAIL (LP) and by Pinta.

TD1.1 Traction Systems demonstrator								
2015	2016	2017	2018	2019	2020	2021	2022	…

Finished: Roll2Rail (Oct. 2017)
Ongoing: PINTA
AWP 2018: CFM
Planned activities

ROLL2RAIL (LP) was completed in 2017 and its results at TRL 3/4 on traction include, among others, the definition of specifications on silicon carbide technology for traction in Light Rail, Metro, Sub - Urban, Regional and High Speed market applications, analysis on the available silicon carbide (SiC) and semiconductor technologies and mechanical outline, architecture, topology development, sensors etc.

The Traction TD is taking the work to a step further via the running project PINTA. In 2017, the project delivered the first set of high-level specifications for the next generation traction systems, and the KPIs targets have been refined for Traction. The development of the traction components and sub-components has started on the different segment lines, i.e. the development of traction converter on tramway; the Sub-Urban Lab converter specification and Hardware design was also done and the work to prepare the system design of a SiC based converter for metro was initiated.

It worth to note that with regard to traction SiC for regional, the result of the studies on traction components and sub-system based on SiC semiconductors revealed that 6 KPIs out of 7 are already improved compared to the Regional case baseline. The main benefits is the reduction of energy consumption (-10%) at train level, traction maintenance cost (-20%), reliability improvement (+15%), weight, volume and noise savings (-10%; -3%; -5%). Moreover, research was conducted in support of TD 1.1, on acoustic noise performance, targets, simulation methods and validation.

The TD is running, in general, according to schedule despite a slight delay concerning the access to data for the development of KPIs. Additionally, towards the end of 2017, the TD realised that the mock-up of a full power e-transformer could be significantly delayed due unavailability of components (high voltage semiconductors). This risk will be assessed and mitigation measures put into place in 2018.

Since the beginning, TD1.1 has reported having accomplished 100% of the planned work up to the end 2017, which represents 65**%** of the overall TD. The TD Traction work, in the PINTA project, will continue in 2018 in order to develop and test up to TRL 5 to 6 traction components and the new traction systems, paving the way for future TRL 7 demonstrations later in S2R.

TDs	TASKS	TRL	2015				2016				2017				2018				2019				2020				2021				2022			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TD1.1	Traction																																	
	1.1.1 Top level requirements	1-2																																
	1.1.2 Development of lab prototypes	1-5																																
	1.1.3 Traction acoustic and EMI noise	1-3																																
	1.1.4 High reliability and availability	1-5																																
	1.1.5 Virtual certification & homologation	1-5																																
	1.1.6 Standardisation for key components and technology transfer	1-6																																
	1.1.7 Demonstration and assesment	7																																

- on-going activities (orange)
- planned activities (blue)

TD 1.2. Train control and monitoring system (TCMS)

The development of a new-generation TCMS (Train Control and Monitoring System) will allow overcoming current bottlenecks caused by physically coupled trains. The new drive-by-data concept for train control, along with wireless information transmission, aims at making new control functions possible; it involves interaction between vehicles and consists, providing high safety and reliability levels with very simple physical architectures.

TD Progress

The TD builds on the progress made by ROLL2RAIL (LP), by the ongoing CONNECTA and Safe4RAIL projects.

TD1.2 Train Control and Monitoring System Demonstrator									
2015	2016	2017	2018	2019	2020	2021	2022	…	

Finished: Roll2Rail (Oct. 2017)
Ongoing: CONNECTA, SAFE4RAIL
AWP 2018: CFM, OC
Planned activities

The TCMS TD is taking stock of the main results achieved in ROLL2RAIL (LP), namely the selection and validation in the laboratory of the LTE communication technology (Long-Term Evolution) for its application to the wireless communication between consists and between trains, to supports the implementation of the WLTB (Wireless Train Backbone), long freight trains and the virtual coupling concept. Another important contribution has been the definition of the new train-to-ground (T2G) standard, of utmost importance to close open points in the TSI Energy and LocPas.

The TCMS TD, via project CONNECTA is taking the work a step further. In 2017, the first set of high-level requirements for the next generation TCMS was delivered. This paved the way for beginning the technical research and developments in the different areas. Regarding the train to ground communication, it was possible to write the software specification for the T2G system and start its implementation, in order to carry out interoperability tests in Q1 2018.

The TD also worked on functional architecture principles (CONNECTA project) developing the use cases and high level requirements for the Functional Open Coupling; a first model of application profiles was built (doors); Specifications and a high level architecture for the Functional Distribution Framework were also provided. A potential architecture for the new generation of brake electronics

to support the full brake-by-wire capability was defined. First RAMS (Reliability Availability Maintainability Safety) analyses also were started as a way to validate the suggested architecture.

The level of maturity achieved by the end of 2017 allowed, with the support of industry experts, the set-up of a demonstrator (i.e. quick-win) named "Connected Trams" to be shown at InnoTrans 2018.

In addition, progress has been made through the work in SAFE4RAIL with the definition of the Drive by Data concept and technology, and with the network requirement collection for the new mixed-criticality network supporting up to SIL4 (Safety Integrity Level) functions. Thanks to the work on Drive-by-Data, it was possible to propose the communication architecture for both the safe ECN (Ethernet Consist Network), and the safe ETB (Ethernet Train Backbone). The communication technology underneath was also proposed with the TSN (Time Sensitive Network). Further steps consisted in supporting the definition of the ETB/ECN conformance test and the outlining of the concept and principles of the virtual certification of TCMS. The first part concluded with the delivery of a number of proposals for the IEC TC9 WG43 standardisation body and the second part produced a set of specifications for the simulation framework and its tooling.

TCMS TD is collaborating with IP2 (TD 2.1) in the definition of an application profile for the ATO (Automated Train Operations), as the preferred way to get this function interfaced with the TCMS.

The TD is running, in general, according to the schedule in coordination with the various projects and initiatives dealing with wireless train-to-train (T2T) communications in IP2 and IP5. Since the beginning, TD1.2 is estimated having accomplished around 95% of the planned work up to the end 2017, which represents 30% of the overall TD.

The TCMS TD work, in the projects CONNECTA and SAFE4RAIL, will continue in 2018 in order to develop and test up to TRL 3/4 some proof-of-concept for the Drive-by-Data, functional distribution framework and simulation framework activities, and up to TRL5 for the WLTB, in order to pave the way for future TRL 7 demonstrations later in S2R phases.

TDs	TASKS	TRL	2015				2016				2017				2018				2019				2020				2021				2022			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TD1.2	Train control and monitoring system (TCMS)																																	
	1.2.0 General specification	-																																
	1.2.1 Wireless TCMS	6/7																																
	1.2.2 Drive-by-data	6/7																																
	1.2.3 Functional distribution architecture	6/7																																
	1.2.4 Virtual placing on the market	6/7																																
	1.2.5 Integration, demo & assessment	6/7																																
	1.2.6 Technical coordination	-																																

on-going activities
planned activities

TD 1.3 Carbodyshell

The new generation of car body shells using composite or other lightweight materials will be a step change in the sector, leading to significantly lighter vehicles that carry more passengers within the same axle load constraints, use less energy and have a reduced impact on rail infrastructure.

TD Progress

The TD1.3 builds on the progress made by ROLL2RAIL (LP); the next set of activities have just started with Pivot and Mat4Rail projects in autumn 2017.

TD1.3 Carbody Shell Demonstrator							
2015	2016	2017	2018	2019	2020	2021	2022

Finished: Roll2Rail (October 2017)

Ongoing: PIVOT,Mat4Rail

Planned activities

The main results achieved in 2017, by ROLL2RAIL (LP) include, among others, car body specification, recommendations for new composite/multi-material car body shell and joining technologies on both urban and High Speed model.

For the urban model, different variables of the car body shell were analysed such as widening door and window pillars, widening the window frame, etc. According to the study, the weight improvement can be between 6% and 20% in the most favourable case which is decreasing the width of the door 300mm (-15% in width). For the High Speed model, different variables were analysed such as the position of the service door, width of door and window pillars, etc. According to the study, the weight improvement can be between 3% and 16%.

A study was done for the preselected materials - the main material alternatives considered for the next generation of the car body included aluminium extruded profile, composite sandwich, etc - showing the structural feasibility of composites, because only some specific zones with concentrated load like lifting points, connection to bogies and couplers need to be metal. The TD work also looked at joints, concluding that where disassembly is required, bolting and screwing would be the best selection. To some extent also riveting and even bonding (secondary structures and elastic adhesives, e.g. windows and glazing, panelling, etc.) could be a viable option. If no disassembly is necessary, a permanent joining technology should be used.

PIVOT will take the work further and develop a risk-assessed demonstrator specification and conceptual car body components for alternative materials, while Mat4Rail will lay the foundation for reducing train weight by replacing metal parts with FRPs (Fibre Reinforced Polymers).

The TD is running according to schedule with the first activities reaching TRL 3/4, which will in turn pave the way for future TRL 7 demonstrations in later/ upcoming S2R phases. Since the beginning, TD1.3 has reported having accomplished 89% of the planned work up to the end 2017, which represents 12% of the overall work of the TD. By the end of 2017, PIVOT and Mat4Rail have not released any deliverables for the year under TD Carbodyshell. According to plan, only one deliverable was scheduled for the end of the year (i.e. technical revision of inputs from prior projects) from PIVOT which is carrying a slight delay of two months.

TDs	TASKS	TRL	2015				2016				2017				2018				2019				2020				2021				2022			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TD1.3	Carbodyshell																																	
	1.3.1 General specification	2																																
	1.3.2 Carbody study	2																																
	1.3.3 Design	2																																
	1.3.4 Behaviour research	3																																
	1.3.5 Manufacturing	4/7																																
	1.3.6 Validation test	4/7																																
	1.3.7 Final report	-																																

on-going activities

planned activities

TD 1.4 Running gear

TD 1.4 will develop innovative combinations of new architectural concepts, new actuators in new lighter materials leading to new functionalities and significantly improved performance levels with the possibility of vibration energy recovery. A mechatronic bogie able to steer through points and crossings will open huge possibilities for a new design philosophy in collaboration with IP3.

TD Progress

The TD1.4 builds on the progress made by ROLL2RAIL (LP), and further activities have just started with Pivot and Run2Rail projects in autumn 2017.

This TD has achieved in 2017 through the results of the project ROLL2RAIL (LP) a Universal Cost Model (UCM) for innovative running gears that can give fair chances to bogie innovations to find their way to the rail market. The UCM can be used in S2R to quantify the economic benefits to vehicle and infrastructure stemming from innovations improving running gear. PIVOT will provide smart solutions for running gear considering functions such as health monitoring and active suspension systems, while Run2Rail will develop case studies on different aspects of running gear such as innovative sensors & condition monitoring, optimized materials & manufacturing technologies, noise & vibration together with a careful assessment of the impacts of the new solutions proposed and evaluation of needed standards.

TD1.4 Running Gear Demonstrator							
2015	2016	2017	2018	2019	2020	2021	2022
Finished: Roll2Rail (October 2017)							
		Ongoing: PIVOT, RUN2RAIL					
					Planned activities		

The TD is running according to the schedule with the first activities reaching TRL 3 that would then pave the way for future TRL 7 demonstrations later in S2R phases. The overall progress appears to be in line with the plan. Since the beginning, TD1.4 has been reported having accomplished 100% of the planned work up to the end 2017, which nevertheless represents a low percentage of the overall TD. By the end of 2017, the ROLL2RAIL (LP) project has released the four deliverables planned for the year under TD Running gear.

TDs	TASKS	TRL	2015	2016	2017	2018	2019	2020	2021	2022
TD1.4	Running Gear									
	Roll2Rail Universal Cost Model	-								
	1.4.1 – Technical specification	3								
	1.4.2 – Sensors and health monitoring	6/7								
	1.4.3 – Optimized Materials	6/7								
	1.4.4 – Suspension & Bogie control technology	3/7								
	1.4.5 – Noise and Vibration	7								
	1.4.6 – System Demonstration Platform Integration	7								
	1.4.7 – Virtual Homologation	3								
	1.4.8 – Reporting	-								

on-going activities
planned activities

TD 1.5 Brakes

The TD on new braking systems aim is to provide braking systems with higher brake rates and in particular to improve performance.

In IP1, the work on brakes is combined with traction innovations, so that the next generation of passenger rolling stock will be able to offer improvements in acceleration and deceleration rates, leading to greater overall line capacity for trains.

TD Progress

The TD1.5 builds on the progress made by the ROLL2RAIL (LP) and by the projects CONNECTA, PINTA, SAFERAIL and PIVOT.

TD1.5 Brake Systems Demonstrator							
2015	2016	2017	2018	2019	2020	2021	2022
Finished: Roll2Rail (October 2017)							
	Ongoing: CONNECTA, PINTA, SAFE4RAIL, PIVOT						
					Planned activities		

TD Brakes has achieved in 2017, through the main results of ROLL2RAIL (LP), an overview on current authorization legal framework and process and the current status on some initiatives to face the identified challenges (such as International Requirement List, Reference Document Database), and a detailed study of requirements on wheel/rail adhesion level plus Wheel Slide Protection (WSP) on stopping distance and safety requirements. Those results constitutes the basis for further work of other projects in the TD. The results of the analysis of authorisation requirements on new braking systems has been provided to ERA to be considered in the process of harmonization of national technical rules.

Via the work in PINTA, the specifications for brakes Adhesion Data Collection, Detection System and Adhesion Modelling have been released along with the Wheel Slide Protection (WSP) Test Procedure Specification and WSP Test Rig Specification. First adhesion measurements have been performed and constitute a basis for the adhesion catalogue. The specifications on the adhesion model will be used as an input for the standard WSP test rig used to reduce commissioning tests. The test bench properties in terms of hardware/software as well as the testing procedure have been defined.

Via the work in CONNECTA, it was possible to define the future architecture of a distributed brake system with a modern new generation of brake electronics to support the full brake-by-wire capability. First RAMS analysis was also started as a way to validate the suggested architecture.
In addition, a preliminary hazard analysis and Failure Mode and Effect Analysis (FMECA) was carried out in collaboration with SAFE4RAIL: the result of this activity is a preliminary safety requirement list that has to be implemented in the next development phase.

The TD is running, in general, according to the schedule despite the slight delay due mainly to changes in the organisations, yet with no impact on the overall work. Since the beginning, TD1.5 has reported having accomplished 93% of the planned work up to the end 2017, which represents 11% of the overall TD. By the end of 2017, the ROLL2RAIL (LP), CONNECTA, PINTA and SAFE4RAIL projects have released ten out of eleven deliverables planned for the year under TD Brakes.

The Brakes TD work, will continue in 2018 with the collection and categorisation of data on low adhesion conditions as well as the build-up of WSP test rigs defined up to now. It will also develop and
test brake electronics hardware and the complete high integrated brake system (pneumatronic) up to TRL4.

The work dedicated to the investigation of future brakes system solutions has just started in October 2017, via the PIVOT project. Subject to the progress achieved, new activities maybe launched as from 2019.

TDs	TASKS	TRL	2015				2016				2017				2018				2019				2020				2021				2022			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TD1.5	Name																																	
	1.5.1 High Safety Level electronic Solutions for Brake Control	4																																
	1.5.2 Adhesion Management Improvement	4																																
	1.5.3 Next Generation Linear Eddy Current Brake (LECB)	6																																
	1.5.4 Innovative Friction Pair Solutions	4																																
	1.5.5 Electro-Mechanic Brake for Railway Applications	4																																
	1.5.6 Vehicle Authorisation Process	4																																

on-going activities
planned activities

TD 1.6 Doors and Access Systems Demonstrator

The TD aims at moving away from current access solutions based on honeycomb and aluminium or steel sheets reducing their drawbacks on energy consumption, noise and thermal transmission. New lightweight composite structures could be introduced to perform better at existing safety and reliability levels, reducing platform dwell times and increasing overall line capacity. Customer-friendly information systems and improved access for people with reduced mobility using sensitive edges and light curtains are part of this new development.

TD Progress

The activities on TD1.6 have just started with PIVOT and Mat4Rail projects in autumn 2017.
PIVOT will work on the specifications for the access door systems and new technologies, architectures and devices, while Mat4Rail will develop the innovative door leaves design looking for improvements in terms of weight, acoustic attenuation and thermal insulation.

TD1.6: Doors and Access Systems Demonstrator							
2015	2016	2017	2018	2019	2020	2021	2022
		Ongoing: PIVOT,Mat4Rail			Planned activities		

The first deliverable from PIVOT on the entrance system specifications is scheduled end of March 2018.

TDs	TASKS	TRL	2017				2018				2019				2020				2021				2022			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TD1.6	Door and Accessibility																									
	1.6.1 Technical Development Prequesites	4																								
	1.6.2 People with Reduced Mobility, Safety and Door Entry Surveillance solutions	4																								
	1.6.3 Improved passengers comfort and weight & energy optimisation	6																								
	1.6.4 Integration in technical demonstrator, Demonstration & Assessment	4																								

on-going activities
planned activities

TD 1.7 Train Modularity in Use (TMIU)

The TD will develop new modular concepts for train interiors that allow operators to adapt the vehicle layout to the actual usage conditions, and will improve passenger flows, thus optimizing both the capacity of the vehicle and dwell times.

TD Progress

The TD1.7 builds on the progress made by the ROLL2RAIL (LP), and further activities have just started with Pivot and Mat4Rail projects in autumn 2017.

TD1.7: Train Modularity In Use (TMIU)							
2015	2016	2017	2018	2019	2020	2021	2022
Finished: Roll2Rail (October 2017)							
		Ongoing: PIVOT,Mat4Rail					
					Planned activities		

This TD has delivered in 2017, through the results of ROLL2RAIL (LP), an analysis on the public perception concerning comfortable and attractive train Interiors and on the existing requirements for interior design. More specifically, the TD has further progressed the research carried out within the first five tasks of WP6 Attractive and Comfortable Interiors of ROLL2RAIL (LP), on the measurement of attractiveness and comfort, the definition of train journey types, the desires of operators and passengers, possible improvements for today and tomorrow as well the limitations for train interior design. The research concluded that there is a need for a metric in order to place a figure on comfort to give it measurable and real value. Furthermore, it highlighted that additional work focused on passenger comfort should be conducted. Other conclusions / recommendations have surfaced, many in areas that are not well covered by standards. Some examples of areas / scopes that would benefit from a rationalisation of standards would be: passenger safety in a crash or passive safety; vandalism resistance; methodology to measure seating comfort; passenger information systems.

PIVOT will work on the concept of modular train interiors to increase flexibility of use and passenger comfort, while Mat4rail will propose solutions for innovative plug & play systems, new seating and innovative driver's desk.

The TD is running according to the schedule with the first activities reaching TRL 3/4 that would then pave the way for future TRL 6 demonstrations later in S2R phases. Since the beginning, TD1.7 has reported having accomplished 100% of the planned work up to the end 2017, which represents 10% of the overall TD as the majority of the work started with the beginning of the PIVOT project in October 2017.

TDs	TASKS	TRL	2015				2016				2017				2018				2019				2020				2021			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TD1.7	Name																													
	1.7.1 Interior modularity	3 or 4																												
	1.7.2 Driver cabins of future	3 or 4																												
	1.7.3 Development	4 or 5																												
	1.7.4 Demonstrator	6																												

on-going activities
planned activities

1.7.2. IP2 Advanced Traffic Management and Control System

The pictures below gives a visual perception on where the TDs will introduce improvements
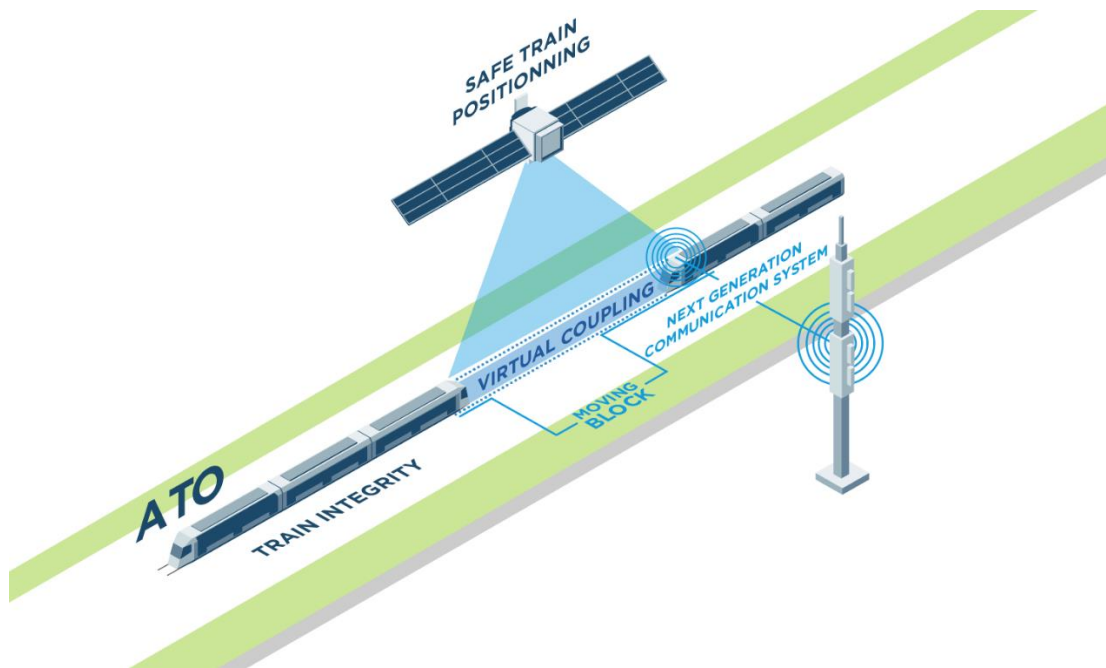
The aim of IP2 is to design and develop a control, command and communication systems that goes beyond being only a contributor to the control and safe separation of trains and becomes a flexible, real-time, intelligent traffic management and automation system.

IP2 builds on ERTMS, that, although limitedly deployed in Europe, including on core rail corridors, appears to be a worldwide dominant solution for railway signalling and control systems, to further develop it exploiting the potential to offer increased functionalities and become even more competitive. Current ERTMS 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. These 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; all in all, the potential for achieving major cost efficiency results for railway operations.

The picture below shows the TDs connections and dependencies within IP1 and with other IPs and CCA.
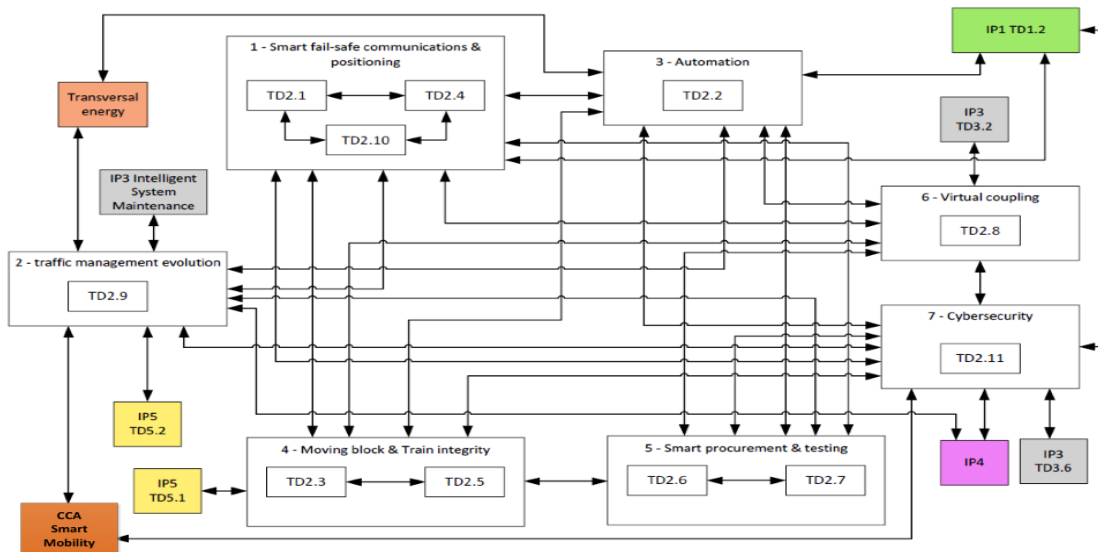
TD 2.1: Adaptable communications for all railways

The purpose of this TD is to overcome the shortcomings in the current European Train Control System (ETCS) and Communications-Based Train Control (CBTC) and deliver an adaptable train-to-ground communications system usable for train control applications in all market segments, using packet switching/IP technologies (GPRS, EDGE, LTE, Satellite, Wi-Fi, etc.). The system will facilitate migration from existing systems such as GSM-R, providing enhanced throughput, safety and security functionalities to support the current and future needs of signalling systems and well beyond; it will be resilient to interference and open to developments in radio technology.

TD Progress

This TD currently builds on the following projects: X2RAIL-1 and MISTRAL.

The main achievement, coming from X2RAIL-1, is the delivery of the user and system requirements for Train to Ground Communications. These requirements encompass functional and non-functional attributes as well as performance indicators for test and verification activities. These are expected to be used to build future systems taking into account the specific needs from the rail sector: critical voice, signalling, critical data and critical video.

These requirements will not only provide a foundation for the telecommunications architectural specification, they will also support business model development and stakeholders across the rail and telecommunications sectors, interested in developing the next generation of railway telecommunications. New requirements for applications interfacing with the telecommunications system are emerging: e.g. train integrity and communications with remote maintenance vehicles.

New telecommunications technologies and capabilities such as those being developed under the '5G' umbrella are emerging making necessary that requirements are periodically updated. An intermediate report was published by MISTRAL on the optimal scenarios of the future Train to Ground communication system.

The TD also identified which directions have to be taken to shift from a network as an asset to a network as a service (NaaS) model. Taking stock of the needs of railway operators and telecom enterprises, the TD set the basis for understanding the conditions to introduce this "NaaS approach". Additionally, synergies with the work carried out within IP1 TCMS communication network are currently sought.

During 2017, 5 deliverables in X2RAIL-1 and MISTRAL were planned and delivered. The overall progress appears to be in line with the plan. TD 2.1 has reported having accomplished 100% of the planned work up to the end 2017.

TD 2.2: Railway network capacity increase (ATO up to GoA4 – UTO)

ERTMS/ETCS, the current generation of main line signalling, faces a growing challenge to provide the performance improvements and increases in line capacity needed by (European) Main Line operators.

Using Automated Train Operations (ATO) with ETCS is an answer to this challenge. This technology is already vastly deployed in urban transport where different grades of automation are implemented including driverless and unattended operation. The objective of this technology demonstrator is to develop and validate a standard ATO up to GoA3/4 over ETCS, where applicable, for all railway market segments (mainline/high speed, urban/suburban, regional and freight lines).

TD Progress

This Technology Demonstrator currently builds on the following projects: X2RAIL-1, launched in 2016 and ASTRail, launched in 2017. X2RAIL-1 is developing the specifications for ATO GoA2 over ETCS (including preliminary design for ATO up to GoA4) while ASTRail focuses on identifying which technologies coming from other application fields could be transferred to the rail sector.

The TD has defined the operational requirements and has issued the first version of the set of specifications for ATO GoA2, a major achievement for the year 2017. This includes the system requirements and the ETCS on-board/ATO on-board interface requirement. Coordination with ERA was launched as well, in order to assess the possible impacts of introducing ATO over ETCS to the ERTMS/ETCS specifications.

This is a major milestone as it will allow the TD, starting from 2018, to proceed to the next stage: the reference test benches and preparation for the pilot tests in 2019.

The first official deliverables are expected at the beginning of 2018. The overall progress appears to be in line with the plan. TD 2.2 has reported having accomplished 100 % of the planned work up to the end 2017.

TDs	TASKS	TRL	2016				2017				2018				2019				2020				2021				2022			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TD2.2	Railway network capacity increase (ATO up to GoA4–UTO)																													
	2.2.1 ATO over ETCS - GOA2 Specification	3-4																												
	2.2.2 ATO over ETCS - GOA2 Product Development	5-6																												
	2.2.3 GOA2 Reference Test Bench Demonstration	6																												
	2.2.4 GOA2 Pilot Line Demonstration	7																												
	2.2.5 ATO over ETCS - GOA3/4 Feasibility Study	3																												
	2.2.6 ATO over ETCS - GOA3/4 Specification	3-4																												
	2.2.7 ATO over ETCS - GOA3/4 Product Development	5																												
	2.2.8 GOA3/4 Reference Test Bench Demonstration	6																												
	2.2.9 GOA3/4 Pilot Line Demonstration	7																												

■ Contracted Activities
■ Planned Activities

TD 2.3: Moving Block

This TD aims at improving line capacity by decoupling the signalling from the physical infrastructure, and removing the constraints imposed by trackside train detection, thereby allowing the transit of more trains on a given (main) line, especially for high-density passenger services. The system is expected to be compatible with existing ERTMS specifications and will enable progression towards CBTC (Communication Based Train Control) functionalities for urban applications.

TD Progress

TD2.3 Moving Block									
2015	2016	2017	2018	2019	2020	2021	2022	...

Ongoing act: X2Rail1, ASTrail
AWP2018: CFM, OC
Planned activities

This TD currently builds on the following projects: X2RAIL-1, launched in 2016 and ASTrail, launched in 2017. X2RAIL-1 will develop moving block operational and engineering rules, system specifications as well as the application analysis while ASTRail will support the development of the hazard analysis.

Work is currently focusing on developing the Moving Block System Specifications and Interface Specifications (based on the moving block scenarios). The specifications will be applicable across all market segments: Urban/Suburban; High Speed Main Line; Low Traffic and Freight. Other tasks related to the safety analysis and prototype developments have also started.

The first deliverables in X2RAIL-1 are planned for the second semester of 2018. However, the work is progressing according to plan.

TDs	TASKS	2016				2017				2018				2019				2020				2021				2022			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TD2.3	**Moving Block**																												
	Task 2.3.1 Moving Block Operational and Engineering Rules																												
	Task 2.3.2 Moving Block System Specifications																												
	Task 2.3.3 Product Specifications																												
	Task 2.3.4 Safety and Security Analysis																												
	Task 2.3.5 Prototype Developments																												
	Task 2.3.6 Test Specifications																												
	Task 2.3.7 Technology Demonstrators																												

Contracted Activities
Planned Activities

TD 2.4: Fail-Safe Train Positioning (including satellite technology)

This Technology demonstrator aims at developing a fail-safe, multi-sensor train positioning system, applying Global Navigation Satellite Systems (GNSS) technology, as an add-on to the current core of ERTMS/ETCS.

It will enable the use of other new technologies (e.g. inertial sensors) or sensors (e.g. accelerometers, odometer sensors) to boost the quality of train localisation and integrity information, while also reducing the overall life cycle costs, in particular by enabling a significant reduction in all conventional trackside (train) detection systems, such as balises, track circuits or axle counters

TD2.4: Fail-Safe Train Positioning (including satellite technology)								
2015	2016	2017	2018	2019	2020	2021	2022	...
		Ongoing: X2RAIL-2; ASTRail						
			AWP2018: OC					
					Planned activities			

TD Progress

This TD currently builds on the following projects: X2RAIL-2 and ASTRail. Both projects started in September 2017 and therefore no deliverables have been released yet.

X2RAIL-2 focuses on the development of the architecture and specifications for satellite positioning and start of laboratory testing and process for field tests. ASTRail will study the requirements and possible knowledge transfer from the aeronautical standards regarding application of GNSS to rail signalling. Collaboration with EASA for the certification of the satellite signal has been started and progress will be monitored during 2018.

TDs	TASKS	TRL	2016				2017				2018				2019				2020				2021				2022			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TD2.4	**Fail-Safe Train Positioning (including satellite technology)**																													
	T2.4.1 – General Specification	NA																												
	T2.4.2 – On site GNSS performance tests																													
	T2.4.3 – Analysis of the results of the GNSS Performance test activities																													
	T2.4.4 – Analysis of the technical solutions for optimizing the GNSS performances in railway environment and proposal for the demonstrators																													
	T2.4.5 – Proof of concept GNSS based localisation devices																													
	T2.4.6 – Process for validation in lab and on field																													
	T2.4.7 – Lab tests	4																												
	T2.4.8 – Update of the technical specifications according to the full test campaign results	4-5																												
	T2.4.9 – Development of Prototypes	4-5																												
	T2.4.10 – Field activities: integration and commissioning tests, validation and certification of the prototypes	4-7																												

Contracted Activities
Planned Activities

TD 2.5: On-board Train integrity

This Technology Demonstrator aims at specifying and prototyping an innovative on-board train integrity solution, capable of autonomous train-tail localisation, wireless communication between the tail and the front cab, safe detection (SIL4) of train interruption and autonomous power supply functionality without the deployment of any fixed trackside equipment. This functionality will be developed for those market segments (e.g. freight and low traffic lines) lacking such functions.

TD Progress

TD2.5: On-board Train Integrity								
2015	2016	2017	2018	2019	2020	2021	2022	...
Ongoing: X2RAIL-2; ETALON				Planned activities				

This TD currently builds on the following projects: X2RAIL-2 and ETALON. Both projects started in September 2017 and therefore no deliverables have been released yet.

X2RAIL-2 will develop the train integrity concept, requirements, system architecture specification and will perform preliminary laboratory tests while ETALON will specifically focus on developing specific solutions for the energy supply for on-board train integrity.

The breakdown of the TD into tasks is as follows:

TDs	TASKS	TRL	2016				2017				2018				2019				2020				2021				2022			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TD2.5	On-board Train Integrity (OTI)																													
	task 2.5.1 Train Integrity Concept	2																												
	task 2.5.2 Definition of Requirements	2																												
	task 2.5.3 Technology Research & Development	3-4																												
	task 2.5.4 Adaptation of Existing Solutions	2-4																												
	task 2.5.5 Demonstration and Assessment	4-6																												
	task 2.5.6 Standardization Proposal	6-7																												

Contracted Activities
Planned Activities

TD2.6: Zero on-site testing (control command in lab demonstrators)

The development of a new laboratory test framework comprises simulation tools and testing procedures for carrying out open test architecture with clear operational rules and simple certification of test results. It aims at minimising on-site testing (with the objective of zero on-site testing) by setting-up full laboratory test processes, even when systems comprise subcomponents of different suppliers. The test framework will also allow remote connection of different components/subsystems located in various testing labs.

TD Progress

TD2.6: Zero on-site testing (control command in lab demonstrators)								
2015	2016	2017	2018	2019	2020	2021	2022	...
	Ongoing: X2Rail1, Vite		AWP 2018: CFM, OC		Planned activities			

This TD currently builds on the following projects: X2RAIL-1 and VITE. New projects stemming from the 2017 CFM and OC call will contribute starting in the second half 2018.

The TD firstly focused on the benchmarking and state of the art in relation to zero-on site testing methods. In 2017, the TD started to develop the overall test process, including the definition of requirements for test environment architecture, system boundaries and use cases, which will be continued in 2018. The work done by VITE is complementing the work of X2Rail-1 in providing a possible different approach to the verification and validation processes.

During 2017, 8 deliverables were planned in X2RAIL-1 and VITE, of which 7 were delivered, one from VITE is slightly delayed. However the overall progress can be considered in line with the plan. TD 2.6 has reported having accomplished 87% of the planned work up to the end 2017.

TDs	TASKS	TRL	2016				2017				2018				2019				2020				2021				2022			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TD 2.6	Zero on-site Testing																													
	2.6.1 Assessment of status quo in field testing and benchmarking	N/A																												
	2.6.2 Definition of test process	3																												
	2.6.3 Define general test architcture	3																												
	2.6.4 Define generic communication model	5-7																												
	2.6.5 Develop / Validate Test environment	5-7																												

Contracted Activities

Planned Activities

TD2.7: Formal methods and standardisation for smart signalling systems

The development of a set of standardised engineering and operational rules aims at contributing to the creation of an open standard interface (if supported by a positive business case) and a functional ETCS description model, all based on formal methods. The objective is to ease the verification, certification and authorisation processes, eventually leading to improved interoperability, while reducing the need for extensive field tests in the future.

TD Progress

TD2.7: Formal methods and standardisation for smart signalling systems								
2015	2016	2017	2018	2019	2020	2021	2022	...
		Ongoing: X2RAIL-2; ASTRail						
					Planned activities			

This TD currently builds on the following projects: X2RAIL-2 and ASTRail. Both projects started in September 2017 and therefore no deliverables were planned and delivered in 2017.
Key activities include review and assessment of the main formal modelling and verification languages and tools used in other applications, choice of application area(s) in rail and application of formal methods to specification, design, verification and validation.

TDs	TASKS	TRL	2016				2017				2018				2019				2020				2021				2022			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TD2.7	Formal methods																													
	2.7.1 Formal methods	3--7						C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	P	P	P	P	P	P	P	P
	2.7.2 Standardized interfaces	6									C	C	C	C	C	C	C	C	C	C	C	C	P	P	P	P	P	P	P	P

Contracted Activities (orange)
Planned Activities (blue)

TD2.8: Virtually – Coupled Train Sets (VCTS)

This technology demonstrator targets the enabling of 'virtually coupled trains', capable to operate much closer to one another, within their absolute braking distance, and to dynamically modify their own composition on the move (virtual coupling/uncoupling of train convoys), while ensuring at least the same level of safety as currently provided.

TD Progress

TD2.8: Virtually – Coupled Train Sets (VCTS)								
2015	2016	2017	2018	2019	2020	2021	2022	...
			AWP2018: CFM, OC					

The activities planned in this Technology Demonstrator will start in 2018, in coordination with the work current on-going in the framework of IP1.

TDs	TASKS	TRL	2016				2017				2018				2019				2020				2021				2022			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TD2.8	Virtually – Coupled Train Sets (VCTS)																													
	2.8.1 Virtual Coupling Concept	2									P																			
	2.8.2 Safety and Performance Analysis	2										P	P																	
	2.8.3 Feasibility Analysis	2													P	P														
	2.8.4 Functional Architecture SAS and FRS	2-3															P	P												
	2.8.5 Functional Architecture FIS	2-3																	P	P										
	2.8.6 Impact Analysis	2-3																					P	P						

Contracted Activities (orange)
Planned Activities (blue)

TD2.9: Traffic management evolution

An optimised Traffic Management System (TD 2.9) aims at improving traffic management operations with automated processes for data integration and exchange with other rail business services. The backbone of the new architecture will be a scalable, interoperable and standardised communication structure applicable within an integrated rail services management system. These features will be combined with new business service applications (e.g. advanced driver advisory system, or intelligent, automated and flexible dispatching systems including conflict detection and resolution) to allow for predictive and dynamic traffic management in both regular and degraded situations. It will use and integrate real-time status and performance data from the network and from the train, using on-board train integrity solutions and network object control functions, supported by wireless network communication. The ambition level of this TD shall be reviewed during 2018.

TD Progress

TD2.9: Traffic management evolution								
2015	2016	2017	2018	2019	2020	2021	2022	...
		Ongoing: X2RAIL-2						
				Planned activities				

This TD currently builds on the project X2RAIL-2. The project started in September 2017 and is progressing as planned, no deliverables were planned and released this year. The principal objective of the project is to design a scalable and interoperable Data Layer providing the data exchange between internal Rail Operation Services and external services.

TDs	TASKS	TRL	2016				2017				2018				2019				2020				2021				2022			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TD2.9	Traffic Management System																													
	2.9.1 Integration Layer	3/4																												
	2.9.2 Shell of the Traffic Management System	3/4																												
	2.9.3 Framework for Traffic Management Business Service	3/4																												
	2.9.4 Applications	6/7																												
	2.9.5 Standardized Operator Workstation	6/7																												
	2.9.6 Functionalities and Interfaces for Dynamic Demand and Information Management	3/4																												
	2.9.7 Integrated Demonstrator	6/7																												

Contracted activities
planned activities

TD2.10: Smart radio-connected all-in-all wayside objects

This TD has for objective the development of autonomous, complete, intelligent, self-sufficient smart equipment ('boxes') able to connect not only with control centres (e.g. interlocking), other wayside objects and communicating devices in the area (by radio or satellite), but also, with on-board units.

These "intelligent" objects - knowing and communicating their status conditions - would not only provide opportunities in terms of cost reduction and asset management improvement, but also establish new means for management and control of railway network information.

TD Progress

TD2.10: Smart radio-connected all-in-all wayside objects								
2015	2016	2017	2018	2019	2020	2021	2022	...
		Ongoing: X2Rail1, ETALON						
					Planned activities			

This TD currently builds on the following projects: X2RAIL-1, launched in 2016 and ETALON, launched in 2017.

In 2017, this Technology Demonstrator analysed the existing lines and economic model from the perspective of the wayside objects, in order to demonstrate the soundness of the concept of object controllers. The TD also analysed the state-of-the-art technologies for wireless data transmission, for power supply and energy harvesting and for maintenance and diagnosis.

The key objectives were to define and demonstrate feasibility of Smart wayside object controllers, connecting with communication networks (wireless, existing, public, etc.), using locally derived power supply, resulting in reduction of power consumption, reduction of required cabling, enabling wireless data exchange with existing and/ or new TMS and enhanced availability of maintenance data. X2RAIL-1 is addressing the railway requirements and standards and developing the system architecture while ETALON will specifically focus on providing an energy harvesting solution for Smart Radio connected wayside objects to minimize trackside infrastructure.

In 2017, two deliverables were planned in X2RAIL-1, one was released. The overall progress appears to be in line with the plan, although the second deliverable is currently under technical review, the TD has reported having accomplished 100% of the planned work up to the end 2017.

TDs	TASKS	TRL	2016				2017				2018				2019				2020				2021				2022			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TD2.10	Smart radio-connected all-in-all wayside objects																													
	2.10.1 Analyses of existing lines and economic models	2																												
	2.10.2 Analyses of railway requirements / standards	2																												
	2.10.3 Definition of system architecture	3																												
	2.10.4 Development and verification of PDs (Prototypes)	5-7																												
	2.10.5 Validation (incl. Integration and Validation at SPD Level – paperwork at P1 / real integration P2)	5-7																												
	2.10.6 Optimisation Works	5-7																												

Contracted Activities

Planned Activities

TD2.11: Cybersecurity

The interconnected digital railway network at European level is constantly growing and will keep on growing, which will increase the number of risks associated to security. There is therefore a growing need for handling these cyber-security threats in railway systems. This technology demonstrator aims at achieving the optimal level of protection against any significant threat to the signalling and telecom systems in the most economical way (e.g. protection from cyber-attacks and advanced persistent threats coming from outside).

TD Progress

TD2.11: Cyber Security								
2015	2016	2017	2018	2019	2020	2021	2022	…
		Ongoing: X2Rail1, Cyrail						
				AWP2018: CFM, OC				
					Planned activities			

This TD currently builds on the following projects: X2RAIL-1 and CYRail. New projects stemming from 2017 CFM and OC call will contribute starting in the second half 2018.

The main achievement of this TD in 2017 is the release of the deliverable linked to the selection of the "secure by design standard", through the evaluation of some of the most common standards, guidelines and best practices in cybersecurity, stemming from several international and national organisations.

The choice of the standard framework resulting from this analysis will be used as basis for railway dedicated secure-by-design standard that may be amended to take into account railway specific

aspects (e.g. safety, life-cycle, etc.) during the development of railway components. CYRail is specifically addressing the security assessment, the threat analysis and attack detection as well as mitigation and countermeasures specification and protection profiles.

In 2017, 8 deliverables relating to this TD were planned in X2RAIL-1 and CYRail, of which 7 were delivered; one was delayed as the actual scope was significantly larger than expected. The overall progress appears to be almost in line with the plan. TD 2.11 has reported having accomplished 87% of the planned work up to the end 2017.

TDs	TASKS	TRL	2016				2017				2018				2019				2020				2021				2022			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TD2.11	**Cyber security**																													
	2.11.1 Cyber Security System: Security assessment limited to ETCS and an urban system	3																												
	2.11.2 Cyber Security System: Threat Detection, Prevention and Response	3																												
	2.11.3 Cyber Security System: Guidelines/standards limited to standardised interface	3																												
	2.11.4 Cyber Security System: Technical demonstrator	5/7																												
	2.11.5 Security by design: basic standard selection and security profile definition	3																												
	2.11.6 Security by design: "security-by-design" standard applied to railway	3																												
	2.11.7 Security by design: technical demonstrator	5/6																												
	2.11.8 CERT: Combining expertize – Designing a holistic knowledge base	2																												
	2.11.9 CERT: Design and validate CERT model dedicated to railway	4																												
	2.11.10 CERT: Design and validate CERT collaborative environment	4																												

■ Contracted Activities
■ Planned Activities

1.7.3. IP3 Cost Efficient and Reliable High Capacity Infrastructure

The pictures below gives a visual perception on where the TDs will introduce improvements
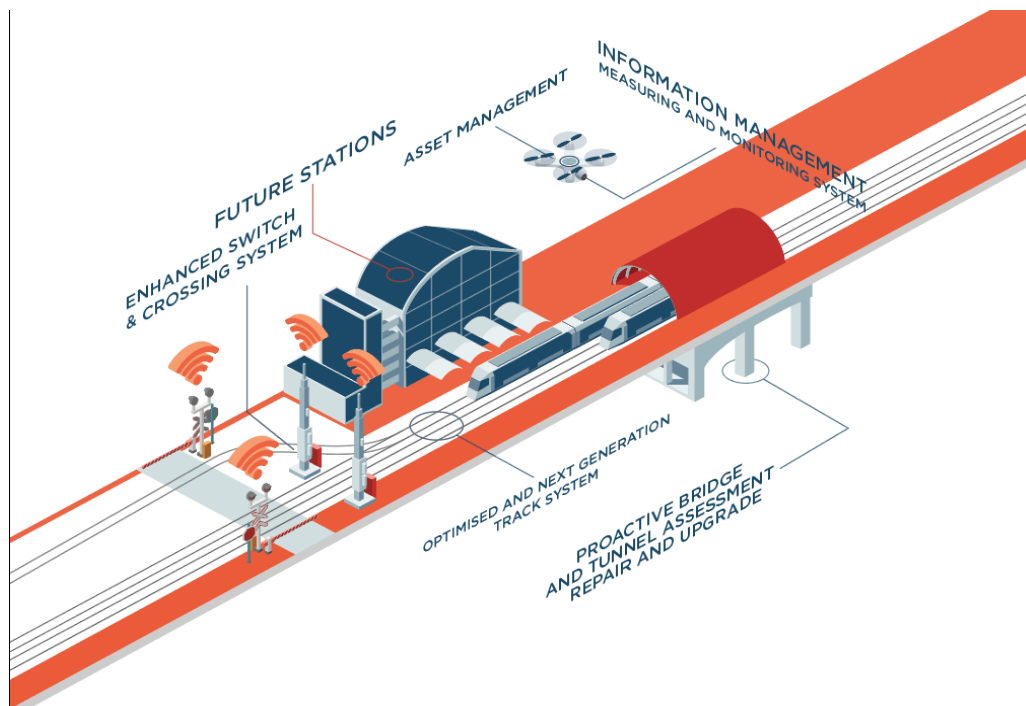
The design, construction, operation and maintenance of rail network infrastructure have to be safe, reliable, supportive of customer needs, cost-effective and sustainable. In order to deliver the benefits of market opening and interoperability and to reduce the life cycle costs of rolling stock and on-board signalling systems, the network diversity needs to be eliminated, notably through a migration towards 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 picture below shows the connections and dependencies within the IP3.
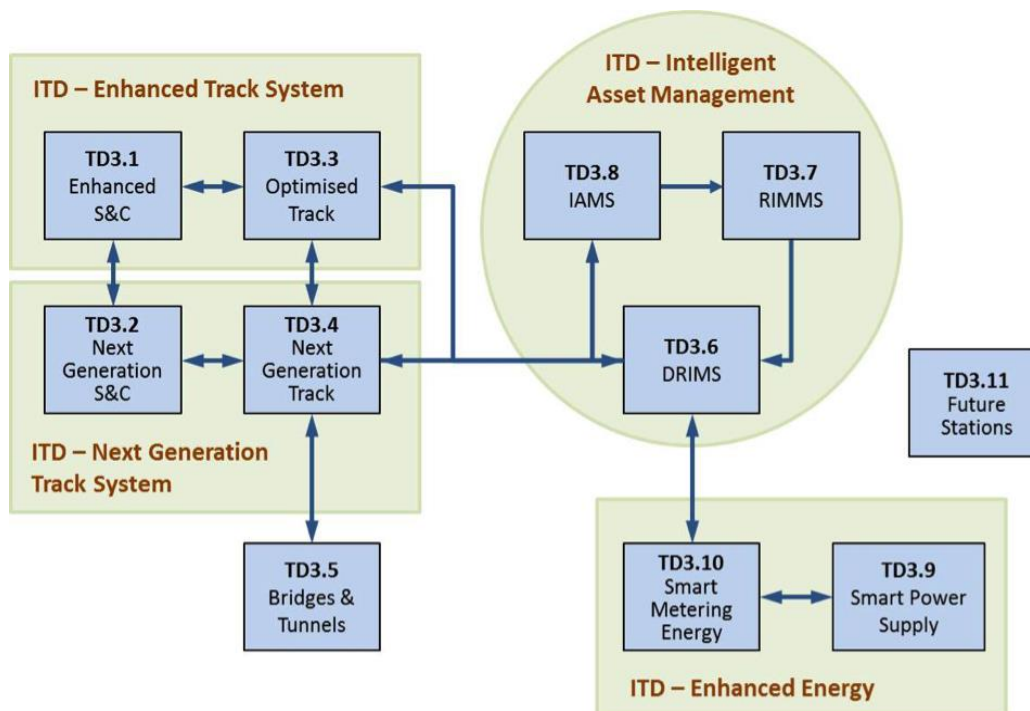
TD3.1 Enhanced Switch & Crossing System Demonstrator

The TD aims at improving the operational performance of existing Switches and Crossings (S&C) designs through the delivery of new S&C sub-systems with enhanced Reliability, Availability, Maintainability and Safety (RAMS), improved Life Cycle Cost (LCC), sensing and monitoring capabilities, self-adjustment, noise and vibration performance, interoperability and modularity.

TD Progress

The work on this TD has started with the IN2RAIL (LP), with considerable progress in identifying best practices for S&C including high-level upgrade specifications for the S&C system and sub-system. Building on this work, the S2R project In2Track focused on whole system modelling, system design, virtual mock-ups and tests. Further input is expected from the project stemming from the CFM call which will start in 2018.
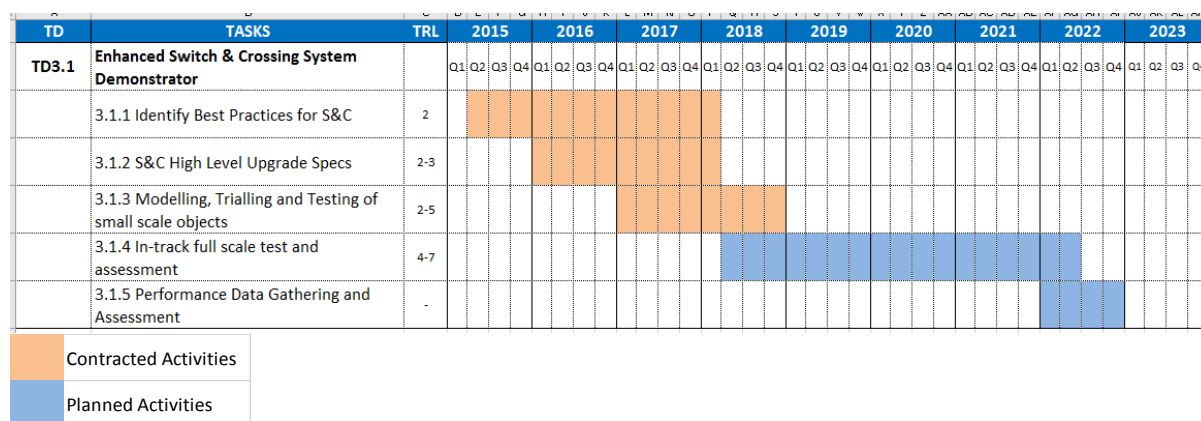
TD3.1 Enhanced Switch & Crossing System								
2015	2016	2017	2018	2019	2020	2021	2022	…
Ongoing: In2Rail, In2Track								
				AWP 2018: CFM				
					Planned Activities			

The work has been completed in the fields of system hierarchy design for embedded sensors including knowledge transfer from other projects and sectors, while the specification of upgradable (sub-) systems including Point Operating Equipment (POE) and embedded sensors is about to be concluded.

Moreover, the whole system modelling has started together with TD3.3 as both TDs share many components in this field. This modelling is based on FMECA results (Failure Mode Effects and Criticality Analysis) and first results with Multi-Body System (MBS) models were achieved.

Certain difficulties faced concerning the modelling trialling and testing of small-scale projects are expected to be overcome in early 2018.

Since the beginning, TD3.1 has reported having accomplished 85% of the planned work up to the end 2017, which represent approximately 13% of the overall TD. During 2017, 1 deliverable was planned and delivered in In2Rail and In2Track had no technical deliverables due.
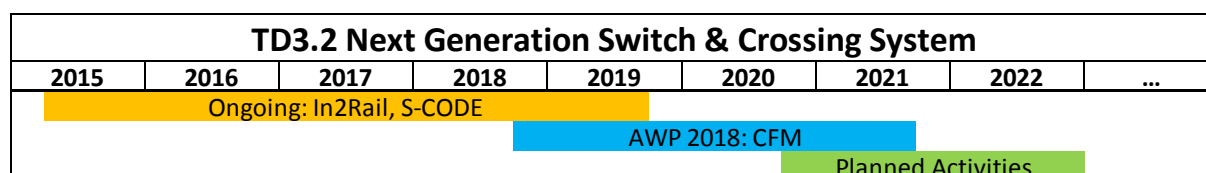
TD	TASKS	TRL	2015	2016	2017	2018	2019	2020	2021	2022	2023
TD3.1	Enhanced Switch & Crossing System Demonstrator		Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4
	3.1.1 Identify Best Practices for S&C	2									
	3.1.2 S&C High Level Upgrade Specs	2-3									
	3.1.3 Modelling, Trialling and Testing of small scale objects	2-5									
	3.1.4 In-track full scale test and assessment	4-7									
	3.1.5 Performance Data Gathering and Assessment	-									

- Contracted Activities
- Planned Activities

TD3.2 Next Generation Switch & Crossing System Demonstrator

The TD aims at providing radical new system solutions that deliver new methods for directing trains to change tracks with the aim of increasing capacity, while reducing maintenance needs, traffic disturbances and life cycle costs.

TD Progress

The main objective of the TD3.2 in 2017 was to identify radically new switch and crossing system and sub-system concepts that have the potential to address existing S&C failure modes whilst also enabling the increase in capacity, reduction of life cycle costs and optimisation of reliability, availability, maintainability and safety (RAMS) performance. During this period, the IN2RAIL (LP) and the S2R project S-CODE have contributed to the related activities of the TD. Further contribution is expected from the projects from the 2017 CFM call starting in 2018. The activities focused specifically on horizon scanning of existing and new design concepts, on the development of a co-simulation model for the introduction of advanced, closed-loop control systems for switch self-adjustment, and on the evaluation of chosen and high-ranking concepts through state-of-the-art multibody vehicle dynamics simulations.

TD3.2 Next Generation Switch & Crossing System								
2015	2016	2017	2018	2019	2020	2021	2022	…
Ongoing: In2Rail, S-CODE								
			AWP 2018: CFM					
						Planned Activities		

In parallel, the TD3.1 project In2Track has initiated work on assessing new materials and manufacturing techniques such as additive manufacturing of the crossing wheel/rail interface region. This work will complement future work within TD3.2.

Considerable steps forward have been made in the areas of mechatronics by establishing the fundamental principles for mechatronics in S&C, by defining safety and performance requirements

and outline designs, by identifying S&C high level expectations. Certain delays were faced concerning the first steps in the development of dynamic models, due to the time taken to evaluate the high level concept designs. Those problems will be tackled in the coming period by closely monitoring progress against targets. This will also require a full business case to understand the overall cost benefits of such solution in liaison with IP1 and IP5.

During 2017, 2 deliverables were planned and delivered in S-CODE. In2Rail did not have technical deliverables due in 2017. Since the beginning, TD3.2 has been reported to have accomplished approximately 15-20% of the overall TD. The progress of the TD compared the overall planning has still to be confirmed.

TD	TASKS	TRL
TD3.2	**Next Generation Switch & Crossing System Demonstrator**	
	3.2.1 Mechatronics Development	2
	3.2.2 Specifications and Modelling Approach	2
	3.2.3 S&C high level specifications	3
	3.2.4 Trial test in controlled environments	3-4
	3.2.5 Small scale tests and assessment of improvements	4-5
	3.2.6 Limited assessment	5-6
	3.2.7 Performance Data Gathering and Assessment	6

Timeline columns span 2015–2022, each divided into Q1–Q4.

Legend:
- Contracted Activities (orange)
- Planned Activities (blue)

TD3.3 Optimised Track System

The TD challenges track construction assumptions, currently implicit in track design, and explores how innovative solutions in the form of products, processes and procedures can provide higher levels of reliability, sustainability, capacity together with LCC savings. The aim is to derive medium-term solutions thus requiring harmonisation with current solutions and regulations.

TD Progress

The main objective of TD3.3 in 2017 was to identify enhanced track system technologies by optimised track system design and maintenance processes. During 2017, the In2Rail undertook preliminary research in the areas of ballasted/non-ballasted track (including transitions zones), noise and vibration reductions, novel weld repair technologies, novel track geometry and thermal monitoring, and optimised tamping techniques. Each of these activities support the goals of TD3.3. In parallel, In2Track has contributed to TD3.3 with research into a wide range of areas. Some areas are already providing concrete operational results: a method of pre-deforming test specimens to obtain deformations corresponding to rail head material in serviced track has been developed and validated. In addition, research commences in a number of areas, such as improved understanding of rail damage mechanisms and efficient countermeasures, enhanced slab track solutions and enhanced use of elastomers etc.

TD3.3 Optimised Track System								
2015	2016	2017	2018	2019	2020	2021	2022	…
Ongoing: In2Rail, In2Track								
				AWP 2018: CFM				
						Planned Activities		

The overall progress of the activities in 2017 is 100%, based on the fact that the three planned deliverables of In2Rail have been submitted in line with schedule. The adoption of results from In2Rail has started, but can of course not be completed until In2Rail is finalized. An important part of the work in TD3.3 is to facilitate the development, assessment and certification of new track technologies through an improved use of simulations and testing. Here the work in In2Rail with overview assessment, detailed technical assessment, and LCC-/RAMS-assessment is taken further. As these tools are improved throughout the S2R Programme, they can also be employed to undertake concept evaluations. Future S2R Calls may take the most promising outputs of In2Rail and In2Track and progress them to higher TRL's within technology and system demonstrators at the same time as new knowledge and new innovations are generated, if accompanied by a full and complete business case.

During 2017, 3 deliverables were planned and delivered in In2Rail. In2Track did not have technical deliverables due in 2017. Since the beginning, TD3.3 has been reported to have accomplished around 30% of the overall TD; further confirmation of the real progress appears to be under examination.

TD	TASKS	TRL
TD3.3	Optimised Track System	up to
	3.3.1 Overview plan and design of optimised track system solutions	2
	3.3.2 Technology identification and development of optimised track system solutions	2
	3.3.3 Definition and outline of demonstrators for optimised track system solutions	2
	3.3.4 Implementation of optimised track system demonstrators	3
	3.3.5 Assessment and technical recommendations	4-5
	3.3.6 Integration in system demonstration platforms	5-7

Contracted Activities

Planned Activities

TD3.4 Next Generation Track System

The TD aims at drastically improving the track system targeting a time horizon of some 40 years beyond present state-of-the art. This implies that step changes in performance are highly prioritized. The TD process follows an integrated chain encompassing initial identification of long-term needs of the railway to the potential solutions to meet these.

TD Progress

The main objective of the TD3.4 in 2017 was to identify radically new track systems, sub-system concepts and transition zone concepts that had the potential to address existing track associated failure modes. The IN2RAIL (LP) undertook preliminary research in the areas of ballasted track, noise and vibration and novel weld repair technologies (via Discrete Defect Repair (DDR)) as well as in hybrid track (including transitions zones) which is the area most relevant to the goals of TD3.4. The project's activities focussed primarily on identifying existing state-of-the-art hybrid track solutions and implementing a novel evaluation framework for new track solutions. This sets the benchmark for assessing future next generation track designs and to establish a consistent methodology for

undertaking comparable cost / benefit analyses. The analysis concluded the feasibility of a novel discrete defect repair technology that may be taken forward for further detailed design and implementation within future S2R Calls. Further inputs are expected from the projects stemming from CFM call which will start in 2018.

TD3.4 Next Generation Track System								
2015	2016	2017	2018	2019	2020	2021	2022	…
Ongoing: In2Rail								
			AWP 2018: CFM					
						Planned Activities		

Compared to the TD planning there is a delay on the horizon scanning of other railway and non-railway technologies and the development of detailed next generation track solution specifications and initial conceptual designs. This activity is planned to be addressed within the Shift2Rail AWP18 and future activities.

During 2017, 3 deliverables were planned and released in In2Rail. Since the beginning, TD3.4 has reported having accomplished 75% of the planned work up to the end 2017, which represent only 5% of the overall TD due to the delayed start.

TD	TASKS	TRL	2015	2016	2017	2018	2019	2020	2021	2022
TD3.4										
	3.4.1 Demonstrator overview plan and design of next generation track system solutions	3								
	3.4.2 Technology identification and development of next generation track system solutions	3								
	3.4.3 Design and definition of demonstrators for next generation track system solutions	3-4								
	3.4.4 Implementation of next generation track system demonstrators	6								
	3.4.5 Technical recommendation and homologation	5-6								
	3.4.6 Integration in system demonstration platforms	6								

Contracted Activities
Planned Activities

TD3.5 Proactive Bridge and Tunnel Assessment, Repair and Upgrade Demonstrator

The main objective of the TD is to improve inspection methods and repair techniques to reduce costs, improve quality and extend their service life when possible without jeopardizing safety. Reduction of noise and vibrations are also among the prioritised objectives.

TD Progress

The main objectives of the TD3.5 in 2017 were to initiate work in fields of tunnel repair, of upgrade of bridges and to start the process of implementation of bridge and tunnel technologies. The S2R project In2Track and the IN2RAIL (LP) have contributed to the related activities of the TD. Further input is expected from the projects stemming from the projects resulting from the 2018 Call. The projects' activities focused specifically on identifying technologies and on investigating approaches to meet the main objective. Moreover, work started on the improvement of tunnel drainage, bridge dynamics, monitoring of bridge fatigue consumption. First results were reached on tunnel drainage inspection and optical bridge assessment, e.g. different photogrammetry methods have been tested and evaluated in term of accuracy with promising results for further research.

TD3.5 Proactive Bridge and Tunnel Assessment, Repair and Upgrade								
2015	2016	2017	2018	2019	2020	2021	2022	…

Ongoing: In2Rail, In2Track

AWP 2018: CFM, OC

Planned Activities

Considerable progress has been achieved in the areas of tunnel inspection, bridge assessment and implementation of bridge technology while certain difficulties and delays were faced concerning the repair of tunnels and upgrade of bridges. Those problems will be dealt with in the coming period through review and intensified supporting on ongoing and planned projects. Deliverables are expected to be submitted on time.

During 2017, 1 deliverable was planned and delivered in In2Rail. In2Track did not have technical deliverables due in 2017. Since the beginning, TD3.5 has reported having accomplished is estimated having accomplished 80% of the planned work up to the end 2017, which nevertheless represents only 5% of the overall TD.

TD	TASKS	TRL	2015	2016	2017	2018	2019	2020	2021	2022	2023
TD3.5	Proactive bridge and tunnel assessment, Repair and upgrade demonstrator										
	3.5.1 Technology identification and development for tunnel inspection and data gathering	1-7									
	3.5.2 Repair of tunnels	1-7									
	3.5.3 Implementation of tunnel technology	1-5									
	3.5.4 Technology identification and development for bridge assessment	1-7									
	3.5.5 Repair of bridges	1-7									
	3.5.6 Implementation of bridge technology	1-5									

Contracted Activities

Planned Activities

TD3.6: Dynamic Railway Information Management System (DRIMS) Demonstrator

The TD defines an innovative system for the management, processing and analysis of railway infrastructure data obtained from TD3.7 (Railway Integrated Measuring and Monitoring System (RIMMS) Demonstrator). The aim is to provide high-quality input to TD3.8. Intelligent Asset Management Strategies (IAMS).

TD Progress

The main objectives of TD 3.6 in 2017 were to initiate the study and design of a canonical data model and to define algorithms and approaches for the standard open interfaces, anomalies detections, process mining and predictive decay related to the railway assets. During this period, the S2R project IN2SMART, has contributed to the related activities of the TD. The In2Dreams S2R project, which started in September 2017, will also contribute to the activities related to data management. As agreed by the two projects IN2DREAMS will integrate the IN2SMART activities providing tools to estimate the accuracy of the IN2SMART algorithms and solutions for analysis results visualization. IN2DREAMS will also provide inputs and ideas on how existing blockchain solutions could be imported in the railway context.

TD3.6 Dynamic Railway Information Management System (DRIMS)								
2015	2016	2017	2018	2019	2020	2021	2022	…
		Ongoing: In2Smart, IN2DREAMS						
					Planned Activities			

The main achievement in 2017 was the definition of storyboards and scenarios. Concerning the standard open interface the objective has been reached as project IN2SMART is identifying the best solutions in terms of modelling, format and data transmission. Other objectives, that have also been partially achieved insofar are anomaly detection and process mining algorithms definition for selected scenarios.

During 2017, 2 deliverables were planned out of which 1 was released for In2Smart. IN2DREAMS did not have technical deliverables due in 2017. It is expected that other deliverables will be released in time, recovering some delays in the activities due to data availability issues.

Since the beginning, TD3.6 has reported having accomplished 70% of the planned work up to the end 2017, which represent 35% of the overall TD.

Contracted Activities
Planned Activities

TD3.7: Railway Integrated Measuring and Monitoring System (RIMMS) Demonstrator

The TD aims at providing innovative tools and techniques for capturing information on the current status of infrastructure assets in a non-intrusive and fully integrated manner. To this end, the TD focuses on infrastructure asset status data collection in close interaction with TD3.1 Enhanced Switch & Crossing System Demonstrator and TD3.5. Proactive Bridge and Tunnel Assessment, Repair and Upgrade Demonstrator.

TD Progress

The main objectives of TD 3.7 in 2017, building on the progress made in previous years, included the specification, design, development and test of an integrated set of cutting-edge on-board and wayside asset-specific measuring and monitoring sub-systems in order to collect and deliver the status data of the railway system. The S2R project IN2SMART and the IN2RAIL (LP) have contributed to the related activities of the TD. IN2SMART mainly focused on innovative monitoring technologies such as unmanned vehicles and drones, signalling systems monitoring and rolling stock impact on infrastructure. IN2RAIL mainly focused on rail stress free temperature monitoring. Both projects contributed to the development of switch and track geometry monitoring solutions. The MOMIT project, which started in September 2017, will also contribute on activities related to aerial unmanned monitoring. MOMIT through its satellite technologies will provide IN2SMART with inputs

aiming at detecting risks affecting infrastructures due to natural events as flood, ground movements. Further input is expected from the project stemming from the call OC which will start in 2018.

TD3.7 Railway Integrated Measuring and Monitoring System (RIMMS)								
2015	2016	2017	2018	2019	2020	2021	2022	…
Ongoing: In2Rail, In2Smart, MOMIT								
				AWP 2018: OC				
					Planned Activities			

The definition of parameters influencing concept developments has been completed for track geometry, rail stress and S&C monitoring (first results already in 2015). For all the other tasks, the work started in September 2016, with the first results achieved in mid-2017 with the definition of storyboards and scenarios, requirements analysis and the starting of the developments phase for the different use cases.

During 2017, 14 technical deliverables were planned for projects In2Rail, In2Smart and MOMIT, out of which 9 were delivered. Since the beginning, TD3.7 has reported having accomplished 85% of the planned work up to the end 2017, which represent 30% of the overall TD.

Progress has been made in all the areas, with some delays in the track geometry measurement and innovative monitoring technologies, due to the very innovative nature of the activities. Those activities are actually speeding up and updates will be given in the upcoming period.

TD	TASKS	TRL	2015	2016	2017	2018	2019	2020	2021	2022	2023
TD3.7	Name										
	3.7.1 RIMMS Tracks	4/5 -7									
	3.7.2 RIMMS S&C	5-7									
	3.7.3 RIMMS Signalling	4-7									
	3.7.4 RIMMS Operation	3/4-7									

Contracted Activities

Planned Activities

TD3.8: Intelligent Asset Management Strategies (IAMS)

The vision of the TD is a holistic, whole-system approach of asset management employing collected and processed infrastructure data provided by TD3.7 Railway Integrated Measuring and Monitoring System (RIMMS) Demonstrator and TD3.6 Dynamic Railway Information Management System (DRIMS) Demonstrator. This includes translating long-term strategies into day-to-day execution of the maintenance and other short term maintenance activities.

TD Progress

Following the work already achieved in 2017 by the TD through the IN2RAIL (LP) in the fields of State of Play and Risk and Asset Management based Strategy, the TD3.8 aimed also at investigating intelligent asset management and execution strategies and new advanced working methods, tools

and equipment, logistics solutions, supporting the LEAN execution of maintenance processes[15]. The S2R project In2Smart and the IN2RAIL (LP) have contributed to the related activities of the TD.

TD3.8 Intelligent Asset Management Strategies (IAMS)								
2015	2016	2017	2018	2019	2020	2021	2022	…
Ongoing: In2Rail, In2Smart					Planned Activities			

In line with the project plan, the main achievements for 2017 relate to the definition of remote command and autonomous system, architecture system design, as well as to the first results reached on the promising example of high speed tamping.

All TD activities are progressing well with the exemption of two areas, which have not yet been covered, namely the clever and smart maintenance (task 3.8.4) and some aspects of work methods and (automated) tools (task 3.8.5) . These areas will be dealt with by future work.

During 2017, 8 deliverables were planned and delivered in IN2Rail and In2Smart. Since the beginning, TD3.8 has reported having accomplished 85% of the planned work up to the end 2017, which represent 25% of the overall TD.

Contracted Activities
Planned Activities

TD3.9: Smart Power Supply Demonstrator

The overarching objective of the TD3.9 is to develop a railway power grid in an overall interconnected and communicating system.

TD Progress

The main objectives of the TD3.9 in 2017 were to define the basic design of demonstrator and investigate the interfaces for it. The S2R project In2Stempo and the IN2RAIL (LP) have contributed to the related activities of the TD. The project's activities in In2Rail focused specifically on the implementation of specification for the intelligent substation and the interfaces with public grid and with TMS/MMS-systems. Basic Design investigations are finished and prepared for handover to CFM-Project In2Stempo. The final deliverables are under preparation.

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[15] the application of the lean manufacturing concept to maintenance operations. Lean manufacturing makes obvious what adds value, by reducing everything else (which is not adding value). This management philosophy is derived mostly from the Toyota Production System (TPS) and identified as "lean" only in the 1990s

TD3.9 Smart Power Supply								
2015	2016	2017	2018	2019	2020	2021	2022	…
Ongoing: In2Rail, In2Stempo								
					Planned Activities			

Moreover, new activities have started in 2017 with the S2R project In2Stempo for the design work for Demonstrator implementation for an intelligent substation. Further Basic design steps are planned for demonstration of flexible alternating current transmission system (FACTS) equipment in the Rail Power Supply.

During 2017, 3 deliverables were planned and released in In2Rail. In2Stempo did not have technical deliverables due in 2017. Since the beginning, TD3.9 has reported having accomplished 100% of the planned work up to the end 2017, which represent 35% of the overall TD.

Considerable progress has been achieved in the areas of intelligent substation and specification of FACTS equipment for Rail power supply. Planned activities for further steps will be handled in future projects.

TD	TASKS	TRL	2015				2016				2017				2018				2019				2020				2021				2022				2023			
TD3.9	Name	TRL	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	3.9.1 Basic design	3																																				
	3.9.2 Application design and demonstrator installation	6/7																																				
	3.9.3 Demonstration and tests	6/7																																				
	3.9.4 Assessment rules and assessment	6/7																																				

Contracted Activities

Planned Activities

TD3.10: Smart Metering for Railway Distributed Energy Resource Management System Demonstrator

The objective of the TD is to achieve a fine mapping of energy flows within the entire railway system, as a basis of any energy management strategy.

TD Progress

The main achievement in 2017 was the definition of the basic design of the demonstrator, through the work carried out in the IN2RAIL (LP). The work in this project also focused specifically on the implementation of a smart metering proof of concept in real railway environment, namely in Reims tramway system. This proof of concept will be presented as a S2R quick-win at InnoTrans event in 2018. Work is in progress to develop the present concept within a professional energy management platform.

The technical solutions described in the basic design deliverables are currently achieved and tested both on-board of one tramway and on ground in one traction substation in Reims. The data collected on field, on a synchronous time basis, is being gathered on a server and the analysis process is now ongoing.

TD3.10 Smart Metering for Railway Distributed Energy Resource Management System								
2015	2016	2017	2018	2019	2020	2021	2022	…
Ongoing: In2Rail, In2Stempo, In2Dreams								

Moreover, work started on the S2R project In2Stempo, while the first results were reached for the starting handover from In2Rail to In2Stempo. In2Dreams is currently working on defining the overall architecture of the integrated communication platform and data management platform - first results are expected early 2018.

During 2017, 3 deliverables were planned and delivered in In2Rail and In2Stempo. In2Dreams did not have technical deliverables due in 2017. Since the beginning, TD3.10 has reported having accomplished 100% of the planned work up to the end 2017, which represent 20% of the overall TD.

TD	TASKS	TRL	2015				2016				2017				2018				2019				2020				2021				2022			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TD3.10	Name																																	
	3.10.0 - Technical Coordination (WP10)																																	
	3.10.1- General Specification (WP4 and WP5)	2																																
	3.10.2 - Architecture Design (WP4 and WP5)	3																																
	3.10.3 - Demonstrator Implementation (WP4 and WP5)	4																																
	3.10.4 - Demonstrator Integration Tests (WP4 and WP5)	5																																
	3.10.5 - Dissemination, Standardization and System Integration (WP10 and WP11)	2																																
	3.10.6 - Demonstration and Assesment (WP4 and WP5)	5																																

▨ Contracted Activities

▨ Planned Activities

TD3.11: Future Stations Demonstrator

The primary objective of the TD is improved customer experience at stations. The TD is organised around four identified key functional demands; two demands relate to improving capacity and security in large stations, one demand relates to the design of small stations with the objective of reducing whole life costs and standardising design where possible and the final demand relates to accessibility.

TD Progress

The TD builds on the activities of the projects In2Stempo and FAIR Stations.

TD3.11 Future Stations								
2015	2016	2017	2018	2019	2020	2021	2022	…
Ongoing: In2Stempo, FAIR Stations								

The main objectives of the TD3.11 in 2017 were to launch the activities in the field of improving customer experience, considering future demands for large and small stations and to improve customer service by improving efficiency, cost effectiveness and security. In particular the focus was to improve flow between platforms and concourse, to improve station designs and components, to

improve the accessibility to trains and to provide emergency strategies for major stations. The S2R In2Stempo and FAIR Stations were launched and started activities in September 2017.

Given the very recent initiation of the activities in this TD the progress appears to be limited to the start-up actions of the projects. Nevertheless, once established, the two projects will have the necessary timeframe to deliver the expected results.

TD	TASKS	TRL	2015				2016				2017				2018				2019				2020				2021				2022				2023			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TD3.11	**Name**																																					
	3.11.1 Crowd Management and Revenue Protection in large stations	6											▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓						
	3.11.2 Standardisation and Prototypes for small stations	7											▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓						
	3.11.3 Platform to Train Accessibility	5											▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓						
	3.11.4 Emergencies Risk Assessment of major stations	4											▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓						

▓ Contracted Activities

▭ Planned Activities

1.7.4. IP4 IT Solutions for Attractive Railways Services

The pictures below gives a visual perception on where the TDs will introduce improvements.

IP 4 aims at designing and developing a system that respond to customer needs to support seamless door-to-door intermodal journeys encompassing different modes of transportation making the use of rail more attractive. Rail must achieve interoperability with other transport modes and mobility services, within different regions, cities and across borders.

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 IP4 is organised on three priority research and innovation areas; the picture below shows the dependencies of the TDs within IP4.
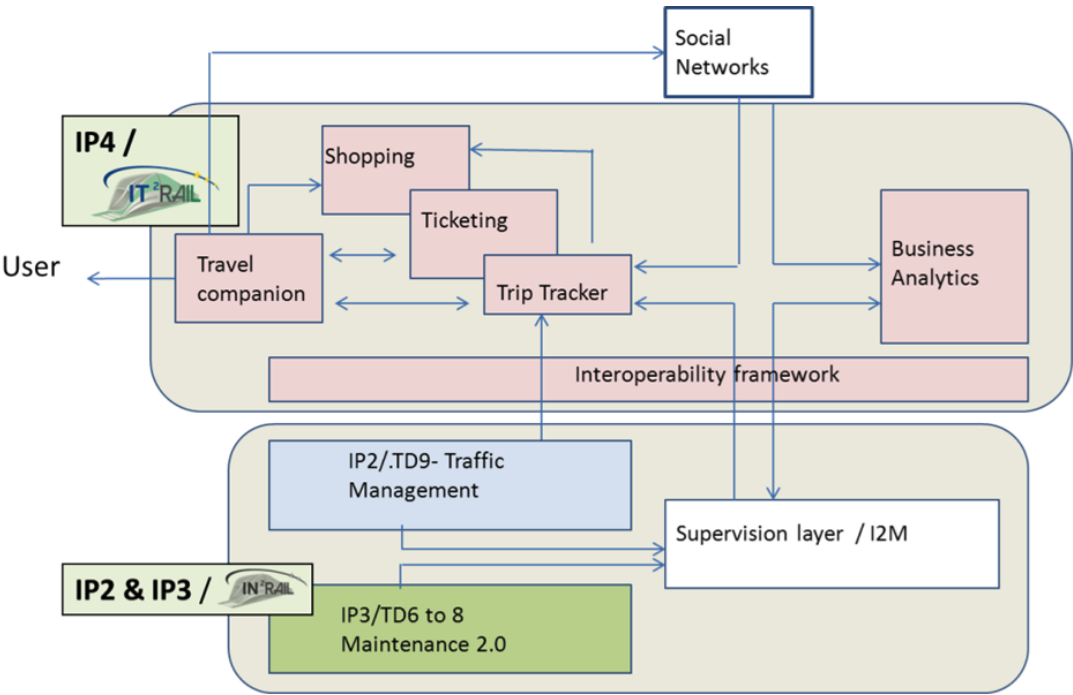
TD 4.1 Interoperability Framework

The aim of the TD is to facilitate multimodal travel in a highly diverse environment and with many transport modes. Interoperability at the semantic level defines formal and explicit models of the transportation domain in an open, standard, machine-readable language that is exchanged automatically by computers, therefore allowing seamless access to all transport data and services in a multimodal and distributed environment. TD4.1 is a key technology enabler for a complete transformation of the European transportation ecosystem.

TD Progress

One of the objectives of the Interoperability Framework TD in 2017 was to continue working within IT2RAIL (LP) in the generation of a set of components to demonstrate the potential of the semantic approach to achieve interoperability. Thus, the project implemented and tested components with basic capabilities to join the ecosystem, expose services and perform queries based on the ontologies defined. In parallel, other TD4.1 projects aimed to work in the architectural principles of the Interoperability Framework, to analyse the state of the art ontology conversion tools and to map standard and reference ontology, and to understand and map the current and future demand for the Interoperability Framework.

TD 4.1 Interoperability Framework								
2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**…**
Ongoing: IT2RAIL, GOF4R, ST4RT, CONNECTIVE								
			AWP 2018: OC					

On one hand, technical work has started in relation to the conceptual design of the converter-generation procedure with annotations for mapping from legacy data models to ontologies, extension of the S2R reference ontology and the creation of shared Subversion (SVN) repository. A significant discovery has been made with the identification of the key legislative risk area (e.g. existing national, commercial and EU regulations) which inhibit access to data. The next step will be to analyse available semantic interoperability solutions from the specificities of the data formats and structures of current rail and transport data sources.

Moreover, there has been interviews with consumers and experts, surveys with end-users and industry actors, desk studies have been undertaken on intellectual property rights, telematics applications for freight and for passengers (TAF and TAP, focused mainly in the second one) and PRM TSI Regulations and National regulations. Also, interaction points for consumers with the Travel Companion TD4.5 have been identified. This will contribute to the elaboration of a consistent roadmap focused on the non-governance aspects. It will complete the whole picture, involve actors in the supply chain as well as technology providers and citizens.

The next step is the deployment of the global interoperable framework, which will provide useful tools, methodologies, resolvers and connectors to allow transport services to share and consume data in different formats. The architecture is currently under analysis and its implementation will allow to move a step forward towards the Digitalization of Transport Ecosystem, and boost the expansion of new transport paradigms and concepts such as Mobility as a Service (MaaS). TD4.1 will allow integrated mobility to each individual and integrated access to a complete offer of Travel Service Providers.

During 2017, 14 deliverables were planned in IT2RAIL (LP), GOF4R, ST4RT and CONNECTIVE of which 9 were delivered. Nevertheless, the delay in the submission of the deliverables will be recovered in 2018 and the overall work reached is estimated at 90%. The overall progress of the Interoperability Framework TD for 2017 is in line with the plan and will continue to reach TRL level 6.

TASKS	TRL	2016				2017				2018				2019				2020				2021				2022			
Interoperability framework		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
4.1.0 Technical Management	NA																												
4.1.1 Semantic definition	5																												
4.1.2 Design of interoperable framework	2 > 6																												
4.1.3 Interoperable data management	2 > 6																												
4.1.4 Interoperable service management	3 > 6																												
4.1.5 Interoperable systems	3 > 6																												
4.1.6 Business rules enforcement	4 > 6																												
4.1.7 Technical Releases and support to ITD7	6																												
Integration and demonstration																													

Planned activity*
Contracted activity

* please note that planned activities from 2019 are progressing in parallel to the already contracted activities

TD 4.2 Travel Shopping

The concept of TD is both to enable, and to respond to, an emerging single European multimodal transport market place within a Single European Transport Area (SETA). The IP4 approach will promote the integration of distributed travel operators' data and services and the orchestration of services such as expert journey planning and offer building. It will benefit of the Interoperability Framework that enables applications based upon different standards or coding lists, to communicate meaningfully but without costly application adaptations with the existing legacy systems of all stakeholders.

TD Progress

The objective of the TD in 2017 was to set up expert groups for facilitating the market uptake. The experts help to produce a general guidance to ensure that the end-user considerations are correctly addressed and provide advice on legal aspects (setting up and running of workshop with standard and regulation bodies) under the scope of project Co-Active.

The TD contributes to enhance technical facilitation of a one-stop-shop capability, to enable comprehensive choice of itineraries and offers from modes/operators able to respond to customer mobility queries, especially through the use of existing services from all stakeholders by interfacing their legacy systems.

TD4.2 Travel Shopping								
2015	2016	2017	2018	2019	2020	2021	2022	…
Ongoing: IT2RAIL, Co-Active, COHESIVE								
				AWP 2018: CFM				
					Planned activities			

Moreover, the TD was tasked to produce overall specifications for the shopping eco-system; define and implement a proof of concept of functions for the orchestration of Travel Experts. Technical work has started with the specification of the actors (persons, systems), capabilities, use cases and architecture (functions, work flow, components, and interfaces).

A significant progress has been made with the Travel Shopper pre-Core Release (preCREL) that now incorporates all the above functionalities. The milestone "Specification for Core Release" was met for Travel Shopping. The next step will be to finalize and implement the Travel Shopping CREL. The implementation, integration and testing of the Core Release is scheduled for February 2018 but the work is facing a slight delay of one or two month.

In order to establish liaison with complementary actions, a workshops with the lighthouse project IT2RAIL (LP) took place. During the whole period technical coordination and system coherence between all projects was more time consuming than expected.

Work on this TD will continue until 2021 in order to reach TRL level superior to 6.
During 2017, 4 deliverables were planned in IT2RAIL (LP) of which 2 were submitted.

The overall progress of the Travel Shopping TD for 2017 is in line with the plan with a slight delay of one month; the estimated completion rate of the planned tasks is 95%, although clarity on delayed deliverables will be part of the assessment of interim project results.

TD 4.3 Booking & Ticketing

Today, even within a given mode (air, rail, urban, etc.), the rights to travel have, in the best case, a limited interoperability between the various travel service operators, and this interoperability is almost non-existent between the modes themselves. The aim of this TD is to orchestrate multiple but parallel interactions with several booking, issuing, payment and ticketing engines, including the all-important roll-back activities. This will radically simplify the traveller's life, by abolishing uncertainties and complexities associated with 'behind-the-scenes' multiple booking, issuing, payment and ticketing processes.

TD Progress

The objective of the TD for 2017 was to develop and integrate a Booking & Ticketing orchestrator able to manage Travel Service Providers with booking and ticketing functionalities. Several TSPs have been incorporated to the ecosystem covering different transport modes such as air, coach, bus and train and integration test have been executed with them. The TD has also enlarged the field of travel rights concepts covered in the IT2RAIL (LP) ontology with the appropriate terms and conditions. The work encompass timing criteria, geographical criteria, disruption conditions and conditions to prevent unexpected re-accommodation of specific travel segments. Furthermore, it considers also financial aspects related to the fare, including penalties and reimbursements. Also new concepts such as ancillary and after-sales services have been incorporated to the ecosystem, as well as introducing the different payments that would be involved in the system together with the clearing and settlement between the actors of the ecosystem.

TD4.3 Booking and Ticketing								
2015	2016	2017	2018	2019	2020	2021	2022	...
Ongoing: IT2RAIL, Co-Active, COHESIVE								
			AWP 2018: CFM					
					Planned activities			

The TD activities are conducted in conjunction with the "Travel Shopping" (TD 4.2) and "Travel Companion" (TD 4.5). The objective is to test the shopping-booking functionalities as well as the "Mobility Request Manager".

The Core Release (CREL) is advanced and is scheduled for the end of February 2018, however the work is facing a slight delay of one or two months.

From the technical point of view, the work develops along 2 main axis:
- review of the IT2RAIL (LP) ontology document in order to integrate the upgrades from the project partners
- development of the Booking & Ticketing orchestrator using Capella (engineering software tool)

Significant results have been achieved with the reinforcement of the Booking & Ticketing architecture.
During 2017, pre-CREL versions of the specifications, ontology and glossary documents have been prepared on the Co-Active project covering the Shopping and Ticketing functionalities.

The TD has completed the tasks planned for 2017 reaching a completion of about 80 % on the overall progress of the activities since the beginning.

The next steps consist in the further development of the application testing environment and the further elaboration of the use-case demo in order to showcase the applications in the next events such as TRA and INNOTRANS.

During 2017, 4 technical deliverables were planned in IT2RAIL (LP), CO-ACTIVE, CONNECTIVE and COHESIVE of which 1 was submitted. The interim review of the projects will assess the delay in the delivery process.

Work in the TD will continue for the next year in the frame of project CO-ACTIVE. Later additional activities are planned in the S2R work programme, subject to the progress and added value of the results achieved.

The components from project IT2RAIL (LP) will be upgraded and enhanced until reaching TRL 6 at the end of CO-ACTIVE.

TDs	TASKS	TRL	2016				2017				2018				2019				2020				2021				2022			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TD4.3	Booking & Ticketing																													
	4.3.0 Technical Management	NA																												
	4.3.1 Specifications and ontologies	5																												
	4.3.2 Entitlement lifecycle software	2 > 6																												
	4.3.3 Commercial management software	2 > 6																												
	4.3.4 Operational management software	3 > 6																												
	4.3.5 Validation management software	3 > 6																												
	4.3.6 Customer relationship management	4 > 6																												
	4.3.7 Technical Releases and support to ITD7	6																												
ITD7	Integration and demonstration																													

	Contracted activity
	Planned activity

TD 4.4 Trip Tracker

The Trip Tracker will assist a traveller throughout his multimodal journey with technologies which accurately and timely notify travellers of any unforeseen difficulties on their individual trip, and providing alternative routes to limit impacts of delays. When a disruption occurs, the TD will provide assistance by calculating with a multimodal approach both whole new itineraries door to door, and from the current position or even only single legs. Trip Tracker will analyse and correlate available static data (such as timetables, topologies), dynamic data (such as road traffic data, transport real time data, operational feeds, social networks) and passengers' data (such as preferences, itinerary, locations).

TD Progress

The basic ideas of a trip tracking system has been designed within IT2RAIL (LP) comprising the activation, disruption detection and alternative managing of an itinerary. In 2017 the development of the architecture has been progressed and finalised so that the technological concept can be (proofed) validated. The objective of the TD 4.4 for 2017 was to expand this concept in the field of interfacing the system with Transport Providers, Infrastructure Managers and social networks.

The focus lays not only on public transport but on all modes of complex journeys including private transport. An essential part of the work in 2017 was to widen the monolithic architecture of IT2RAIL (LP) to a modular one.

TD4.4 Trip Tracker								
2015	2016	2017	2018	2019	2020	2021	2022	...

Ongoing: IT2RAIL, Attracktive, My-TRAC

AWP 2018: CFM

Planned activities

Work has also started for the development of a mechanism to filter the relevant data and the relevant events to the tracked journeys. Apart from identifying the events per mode (multimodal approach) combining information from multiple modes, it will help to detect and generate new events, as well as to predict the impact they can have in other transport modes.

The modular architecture requires several interfaces; one is the interface between the Tracking Orchestrator and the partial Trip Trackers. As the standard interfaces like SIR, TRIAS and OJP do not fit to the needs of the novel architecture a lean and specialised interface had been decided on.

A milestone "specification for the pre Core Release" was reached in April 2017. The next step is the finalisation of the Core Release specification and its implementation scheduled for February 2018, however the work is facing a slight delay of one or two months.

As the TD analyses traveller centred decision factors, an Advisory Board with relevant experts was setup, giving high importance to data protection and ethical standards.
During the whole period technical coordination and system coherence between all projects has been more time consuming than expected.

During 2017, 5 technical deliverables were planned in IT2RAIL (LP) project of which none have been submitted. Within ATTRACkTIVE and My-TRAC no deliverables were planned. The interim review of the projects will assess the possible issues in the delivery process.

Regarding the progress it must be distinguished between the three projects in charge of TD 4.4. By an official amendment IT2RAIL (LP) has been expanded by 6 months including final presentation during the TRA2018 in Vienna in April. The above mentioned deliverables planned for 2017 will be finalised directly after the ongoing tests of the WP4 System. Taking this into account WP4 of IT2RAIL (LP) has a status of around 75 % readiness. The project ATTRACkTIVE has an overall progress of about 80% in TD 4.4 compared to the plan. My-TRAC started in September 2017 is due to the short running period mainly right on schedule. The work in the Trip Tracker area will continue until 2020 in several running and upcoming projects; later additional activities are planned in the Shift2Rail work programme. The Trip Tracker Demonstrator targets TRL 5 whereas the technical demonstrator will reach TRL 6.

TDs	TASKS	TRL	2016	2017	2018	2019	2020	2021	2022
TD4.4	**Trip Tracker**		Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4
	4.4.0 Technical Management	NA							
	4.4.1 Specifications and ontologies	5							
	4.4.2 Static data interface	2 > 6							
	4.4.3 Dynamic traffic data interface	2 > 6							
	4.4.4 Passenger data interface	3 > 6							
	4.4.5 Real-time event processing	3 > 6							
	4.4.6 Alternative itinerary building	4 > 6							
	4.4.7 Technical Demonstrator & Support to iTD7	6							
ITD7	Integration and demonstration								

Contracted activity
Planned activity

TD 4.5 Travel Companion

The overall objective of the TD is to research, implement and evaluate a seamless and interoperable platform offering new levels of interaction between travellers and transportation stakeholders along with an innovative ubiquitous adaptive front-end to the global transportation service ecosystem.

Thanks to their own personal and secured '*Travel Companion'* travellers will have access to all travel services needed for the journey, shopping and booking as well as novel forms of experiences which extend and transform the journey to a real door to door experience.

TD Progress

The TD objective for 2017 was to continue the work performed in IT2RAIL (LP); 40% of the modules used within ATTRACKTIVE are coming from IT2RAIL (LP) without modification. The other modules are derived from IT2RAIL (LP) modules with modifications or are new modules set up by ATTRACKTIVE .

The TD has progressed availing with the activities of the ATTRACKTIVE project. Work has started in various work streams:
1. Improvements on the modular architecture of IT2RAIL (LP) to provide a system with more interactions between the different modules and support future platform developments
2. Homogenized interface for the user experience
3. Creation and edition of novel forms of Location Based Experiences
4. Data acquisition (e.g., positioning, feedback, …) and exploitation in the TD4.4 "Trip Tracking"
5. Complete reuse of the IT2RAIL (LP) Cloud Wallet in Shift2Rail to develop a user virtual space on a scalable and secure cloud architecture that is central to the programme and will communicate with all IP4 TDs

TD4.5 Travel Companion								
2015	2016	2017	2018	2019	2020	2021	2022	…
Ongoing: IT2RAIL, Attracktive, My-TRAC								
			AWP 2018: CFM					
						Planned activities		

The implementation of the core release (v1) has started; however, the core release needs to incorporate more inputs (specification of all functions developed within all tasks of TD4.5) in order to be finalised. This is the reason of the TD running slightly behind schedule regarding this task. It is estimated that the core release incorporating all the specifications and the implementations will be delivered with a short delay of one or two months after the original due date (02/2018).

The project My-TRAC started in September 2017 and is analysing how to collaborate with ATTRACKTIVE for the Travel Companion TD. My-TRAC started analysing traveller centred decision factors which are affected both internally (user related) and externally (service related). In addition, the TD started collecting data from relevant project partners and contacts in the view of forecasting for multiple objectives and user preferences.

From the technical point of view, the data collection and further specification of the ontology for the travel companion paves the way for the further implementation of a modular travel companion platform.

A significant effort has been faced to align the schedules of all IP4 projects involved in the TD in order to be able to share and reuse the outcomes between all of the projects.

During 2017, 6 technical deliverables were planned for IT2RAIL (LP), ATTRACKTIVE and My-TRAC of which 3 were submitted. The delayed delivery process will be assessed in the interim review of the concerned projects.

The overall progress of the activities since the beginning is 50% compared to the schedule.
Activity in this TD will continue until 2022 and is expected to reach TRL 7.

TDs	TASKS	TRL	2016				2017				2018				2019				2020				2021				2022			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TD4.5	Travel Companion (on going developement)																													
	4.5.0 Technical Management	NA																												
	4.5.1 Specifications and ontologies	5																												
	4.5.2 Secured Cloud-based Platform	2 > 6																												
	4.5.3 Passenger Services	2 > 6																												
	4.5.4 External Connectivity	3 > 6																												
	4.5.5 Navigation	3 > 6																												
	4.5.6 Device tapping	4 > 6																												
	4.5.7 Technical releases and support to ITD7	6																												
	Planned development	2 > 6																												
	Planned development	2 > 6																												
ITD7	Integration and demonstration																													
	Innotrans 2018 release	2 > 6																												
	beta release for Innotrans 2020	2 > 6																												
	Final release	2 > 6																												

contracted activity
planned activities

TD 4.6 Business Analytics

The TD will provide a common business intelligence foundation for all products and services transport providers based on the access to open-ended web of transportation data offered by the Interoperability Framework (TD4.1).

Based on descriptive, predictive and prescriptive analytics using multimodal data sets generated by the services developed in IP4, the TD will help the passenger carriers to better adapt their level of service to the passengers demand and to optimize their operations. TD4.6 will also provide interactive and dynamic visualization capabilities.

As data privacy is an important issue in transportation and European GDPR – General Data Protection Regulation – will be operational in 2018, anonymization services and data generation algorithms will be developed to guarantee privacy and confidentiality.

TD Progress

TD4.6 Business Analytics								
2015	2016	2017	2018	2019	2020	2021	2022	...
	Ongoing: IT2RAIL, GOF4R, ST4RT, CONNECTIVE							
						Planned activities		

The TD objective for 2017 relies mostly on work performed in IT2RAIL (LP), in which the initial functionalities and requirements were identified. IT2RAIL (LP) project has defined ontologies, implemented software components such as presentation layer, information management and analysis tools, data management and storage. Using external or simulated data, the functionalities of the TD provided KPIs and business intelligence on: happenings that will take place at a location/recommendations, KPIs computation based on messages retrieved from Social Network

platforms, information on current Weather and Forecasts, travel questionnaire for the traveller to give feedbacks on the trips and generate KPI of quality.

The TD is progressing with the activities of CONNECTIVE project which is continuing the works initiated in IT2RAIL (LP), and set as objectives for 2017 to start to understand business needs and data that will be available and used. As no real data has been produced by the IP4 ecosystem, activities availed with the provision of real data coming from operators, with data similar to data that will be produced in IP4 (ticketing data, mobile phone application data…) and with simulated/generated data based on IT2RAIL (LP) results and samples of data produced in IP4 ongoing projects.
Work in this TD will continue until 2022, supported by the activities of project CONNECTIVE.

During 2017, 4 technical deliverables were planned in IT2RAIL (LP) (2 submitted) and CONNECTIVE, 4 deliverables planned for GOF4R (1 submitted) and 3 deliverables for ST4RT of which all were submitted.

The overall progress of the activities since the beginning is 80% compared to the schedule.,

* please note that planned activities from 2019 are progressing in parallel to the already contracted activities

ITD 4.7 Integrated Technical Demonstrator

At the core of the ITD, lies the objective of opening the transportation ecosystem to new business actors, able to rejuvenate the transportation ecosystem technologies and business models, thus achieving the goals of European leadership in the market. The ITD will release, on a regular basis and for all TDs, successive versions of enriched deliverables, from early conceptual prototypes to the final version. It will act as the orchestrator of other TDs' developments, and will ensure the systems approach to integrate the different TDs' results.

ITD Progress

The ITD objective for 2017 was to address the coordination of technical activities including activity planning and follow-up, definition and production of the technical management documentation used to guarantee effective monitoring and control of activity and its progress

ITD4.7 Integrated Technical Demonstrator								
2015	2016	2017	2018	2019	2020	2021	2022	...
Ongoing: IT2RAIL, COHESIVE								
			AWP 2018: OC					

Activities in ITD4.7 are mainly provided by project COHESIVE that started in September 2017; further inputs will be provided in 2018. The first action of the project was to introduce overall technical management and organisation rules to be shared by the partners, with the aim to offer robust, yet

tailored, means of monitoring and control of the WPs progress. It is foreseen to produce a first set of guidelines to address the technical project management and the WPs internal management to guarantee the project consistency, by defining methods, guidelines and mandated procedures to follow throughout the WPs own lifecycles. This technical principle description report is in its final phase of production, to be issued in the end of January 2018.

Most of the initial, preparatory and setup activities undertaken in COHESIVE were based and supported on the experience acquired and lessons learnt from running projects, and addressed the definition of methodologies and mechanisms to guaranty efficient communication, information sharing and interfacing among a set of projects each having their own programs, planning and objectives. Although targeting a common objective the formal separation stemming from specific Contractual Agreement and Grant Agreement for these projects, needs to be overcome to ensure overall targets, consistency and fluidity desired by the ITD.

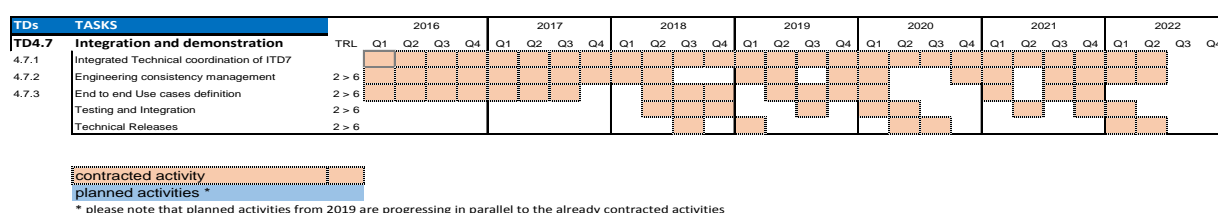During 2017, 7 technical deliverables were planned in IT2RAIL (LP) and COHESIVE of which 1 was submitted.
This execution below the target is justified by the existence of delays in Trip Tracker and Travel Companion activities undertaken in TD4.4 & TD4.5 of which this TD makes the takeover of the integration activities.

The documentation and integration activities undertaken in the nearly finished IT2RAIL (LP) are similar to those in Cohesive and sometimes done in parallel, supporting each other.

The preparation of the integration and demonstration of results to be done in InnoTrans 2018 is also being done in parallel between IT2RAIL (LP) and Cohesive. Such close connexion between IT2RAIL (LP) & COHESIVE activities induces also delays in the evolution of some TD task achievements.

Nevertheless, the TD is reporting having completed the tasks planned for 2017 up to 60 %; an in depth analysis of the delivery process of this TD will take place in the final and interim review of the concerned projects.

Work in this ITD will continue until June 2022, mainly with the support of project COHESIVE. The TRL is expected to be superior to 6 for the final release in 2022.

TDs	TASKS		2016				2017				2018				2019				2020				2021				2022			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TD4.7	Integration and demonstration	TRL																												
4.7.1	Integrated Technical coordination of ITD7																													
4.7.2	Engineering consistency management	2 > 6																												
4.7.3	End to end Use cases definition	2 > 6																												
	Testing and Integration	2 > 6																												
	Technical Releases	2 > 6																												

contracted activity
planned activities *

* please note that planned activities from 2019 are progressing in parallel to the already contracted activities

1.7.5. IP5 Technology for Sustainable and Attractive European Rail Freight

The picture below gives a visual perception on where the TDs will introduce improvements. Please note that the TD structure presented in this Report do not yet reflect the upcoming IP5 structure improvement which is currently ongoing with the MAAP Part-B update.
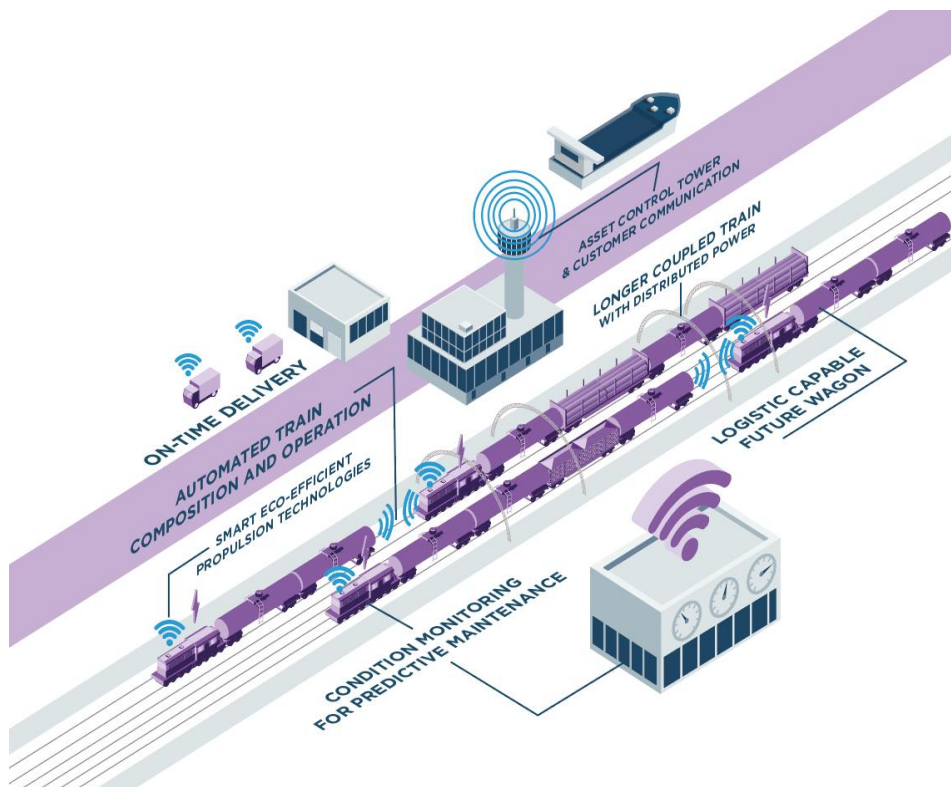
This IP aims at improving the cost competitiveness and the reliability of freight services of the rail sector in order to meet the ambitious objectives of almost doubling the use of rail freight compared to 2005. This will allow achieving the White Paper objective of a shift of 30% of road freight over 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. Work focus on different market segments with specific technical and operational characteristics and needs.

TD5.0 *'Implementation Strategies and Business Analytics'*

This TD ensures that IP5 develops technologies in line with the market needs and with sound plans for introductions into the market. This is provided by migration plans for implementing new technology solutions on a large scale, identifying market segments and developing specifications and Key Performance Indicators for freight.

TD progress

TD 5.0 – Business analytics and implementation strategies								
2015	2016	2017	2018	2019	2020	2021	2022	…
Lighthouse Project: SMART-RAIL								
	Ongoing: FR8RAIL, INNOWAG, FR8HUB							

This TD builds on the following projects: SMART-RAIL (LP), FR8RAIL, FR8HUB and INNOWAG. One main objective in 2017 was to have an overview of all relevant segments of the rail freight market, its characteristics and its technical and logistical challenges. For that, FR8RAIL started an analysis of preliminary results of the lighthouse project SMART-RAIL (LP) on new business models supporting cooperation and guidelines describing the data governance approach

Furthermore, the TD progressed by identifying and assessing market drivers, identifying current technologies and defining requirements and specifications for cargo condition monitoring, wagon design and predictive maintenance. Alongside the S2R KPIs, specific Performance Indicators were identified in INNOWAG and defined for assessing the economics, maintenance, efficiency performances and requirements proposed for further developments. Two use cases have been developed in TD5.1: container wagon with sensitive goods and a tank wagon carrying hazardous goods.

This work on benchmarking of the technologies and processes, market drivers' definition and specifications shows the way forward in 2018 towards the conceptual wagon design in TD5.3. In general, the analysis of freight railway market showed that supply chains have become more complex and sophisticated requiring innovative services, new wagons should be more standardised and based on modular design; greater attention should be given to the maintenance aspects of rolling stock. Moreover, market trends indicate that there is a great demand and potential uptake of intelligent lightweight freight wagons. Those wagons should satisfy the needs of carrying high value, low density goods and time sensitive goods.

The TD moved forward on developing a set of concepts, methods and tools for improvement of the rail freight service (such as efficiency, reliability, flexibility and capacity use) by cooperation within the rail sector and also within the supply chain. It developed governance models of behaviour for enhancing the cooperation and a guideline describing the data governance approach and an ontology based on semantics (SMART-RAIL (LP) result).

During 2017, 17 deliverables were planned in SMART-RAIL (LP), FR8RAIL, FR8HUB and INNOWAG of which 15 were delivered. The overall progress appears to be in line with the plan. Since the beginning, TD5.0 has reported having accomplished 90% of the planned work up to the end 2017, which represent 75% of the overall TD. The KPI activity is heavily dependent on CCA activity which might delay this work.

TDs	TASKS	TRL	2016				2017				2018				2019				2020			
TD 5.0	**Name**		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
5.0.1	Identification of market Segments	n/a																				
5.0.2	Development of Specifications and KPI	n/a																				
5.0.3	Migration Plan	n/a																				

	Contracted activities
	planned activities

TD5.1 Freight Electrification, Brake and Telematics

This TD targets the adoption of two global megatrends for freight rolling stock: the automatic coupling for freight trains, which is an important enabler for reliable data connections through the train, and digitisation of rolling stock, which leads to smart, connected assets that offer the necessary information for improved services. The TD focuses on areas such as condition-based and predictive maintenance of locomotives and wagons and wagon monitoring systems, telematics and electrification.

TD progress

TD5.1 Freight electrification, brakes and telematics								
2015	2016	2017	2018	2019	2020	2021	2022	…

Ongoing: FR8RAIL, INNOWAG, FR8HUB

AWP2018: CFM

Planned Activities

This TD currently progress through the work performed in FR8RAIL, FR8HUB and INNOWAG projects. Further inputs are expected from the project stemming from the call CFM.

In 2017, the TD aimed at developing high level architecture, listing components, feedings and revising all relevant maintenance tasks within the area of condition based and predictive maintenance. For that, FR8RAIL developed a four steps maturity model to reach the target of overall condition based and predictive maintenance program. The results for the locomotive type BR 189 showed that the top 10 components account for large percentage of the total costs.

In the area of telematics and electrification requirements and technology evaluation activities have been performed for the four main functions defined for the intelligent wagon such as communications (including wireless technologies on rolling stock compositions), positioning, wagon monitoring and cargo monitoring. Energy management based on energy harvesting/batteries/electrification is an open issue due to the defined number of subsystem defined requiring energisation (sensors, wOBU, automatic coupler, …) During this period, INNOWAG highlighted the advantages of the technology concept of a system based on an autonomous self-powered wireless sensor network (WSN) for cargo tracing and monitoring the condition of key parameters for critical types of cargo. The proposed system could overcome the issues related to sensor wiring and power supply on freight trains by using a wireless communication network powered by energy harvesting solutions.

In the area of automatic coupling, FR8RAIL reported an exhaustive and articulated description of existing automating wagons coupling systems. Data transmission technology and architecture of the wagon was defined which had a high impact in the interfaces definition. The main contribution is a preliminary technical requirements list.

New activities for this TD started during the last part of the year, focusing on the definition of relevant scenarios and high-level requirements for wagon bogie maintenance and the definition of wagon bogie monitoring architecture (FR8HUB project).

During 2017, 6 deliverables were planned in FR8RAIL, INNOWAG and FR8HUB out of which 5 were released. The overall progress appears to be in line with the plan. Since the beginning, TD5.1 has reported having accomplished 99% of the planned work up to the end 2017, which represent 20% of the overall TD.

TDs	TASKS	TRL	2016				2017				2018				2019				2020				2021				2022			
TD 5.1	Name		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
5.1.1	High level specification definition, feasibility analysis and preliminary testing	n/a																												
5.1.2	Conceptual / architecture design	3																												
5.1.3	Detailed design, implementation and unitary testing	4																												
5.1.4	Integration of components	5																												
5.1.5	Demonstration activities	6																												

Contracted activities

planned activities

TD5.2 'Access & Operations'

This TD is targeting the digitisation of processes to optimise service planning and operation thanks to real-time data gathering, steering, operation and coordination of intermodal transport at higher speed. This supports better utilisation of available capacity, by optimising access and operation of local hubs which are essential but cost-intensive subsystems for rail freight business.

TD progress

TD5.2 Access and Operation								
2015	2016	2017	2018	2019	2020	2021	2022	…
Ongoing: ARCC, SMART, OPTIYARD, FR8HUB								
AWP2018: CFM								
Planned Activities								

This TD builds on the following projects: ARCC, SMART, OPTIYARD and FR8HUB. Further input is expected in 2018 from the project stemming from the call CFM.

The 2017 TD's goal was to acquire a common understanding of the decision making and processes in the nodes and to start defining the requirement of yard management and the connection between yard and network.

The TD delivered the list of requirements for the real-time marshalling yard management system aiming at establishing a sustainable and efficient real-time optimization during further activities planned in next phases (SMART project).

Building on this the TD aimed at classifying the different types of marshalling yards and terminals and developing a common understanding and description of operational procedures and rules in these types of local hubs (ARCC project). This leads to the development of a common understanding of decision processes, their optimisation and automation potential in different types of local hubs.

An analysis of operational procedures and decision-making in marshalling yards and terminals was conducted in Germany and Sweden. The result showed that a predictive system that pro-actively could inform the decision makers in the yard on the consequences of possible actions is currently not available but it would be desirable. The TD made the first steps in the area of improved methods for timetable planning with a study that will be delivered next year by the project ARCC. The entire TD will be aligned with the involvement of FR8HUB and OPTIYARD projects in the second part of the year.

During 2017, 6 deliverables were planned and delivered in ARCC, SMART, OPTIYARD and FR8HUB. The overall progress appears to be in line with the plan. Since the beginning, TD5.2 has reported having accomplished 100% of the planned work up to the end 2017.

TDs	TASKS	TRL	2016				2017				2018				2019				2020				2021				2022			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TD 5.2	Name																													
5.2.1	Improved Methods for time table planning	5				▨	▨	▨	▨	▨	▨	▨	▨		▦	▦	▦	▦	▦	▦	▦	▦								
5.2.2.	Real-time Yard Management	7				▨	▨	▨	▨																					
5.2.3	Real-time Network Management	5						▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▦	▦	▦	▦	▦	▦	▦	▦	▦	▦	▦	▦
5.2.4	Increasing speed of freight trains during day time traffic to increase line capacity	5						▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨									

▨ Contracted Activities
▦ Planned Activities

TD5.3 Wagon Design

This TD has the objective of delivering technical demonstrations of next generation running gear and wagons for freight. The next generation freight wagons will improve the competitiveness of rail freight logistics by providing more flexible and reliable high-capacity assets at competitive costs.

TD progress

TD5.3 Wagon design								
2015	2016	2017	2018	2019	2020	2021	2022	…
	Ongoing: FR8RAIL, INNOWAG							
			AWP2018: CFM					
						Planned Activities		

This TD builds on the following projects: FR8RAIL and INNOWAG. Further input is expected in 2018 from the

In 2017 the TD activities focused on describing and assessing the state of the art solutions for freight wagon designs, running gear including wheel sets & braking technologies according the 5L-approach. The analysis included evaluations of the designs regarding track & wheel friendliness but also aero-acoustical and aero dynamical performance to minimise the life cycle costs. In this context, a report documenting state of the art concepts and innovations, and problem statements was compiled and delivered by the project FR8RAIL. Based on this report, and on further design and business metrics, different concepts for the wagon designs for the core and extended market have been carried out. Promising results have been achieved when the designed concepts were assessed and benchmarked on their track friendliness by means of simulation. The final report on the developed and chosen concepts on running gear and wagon design is being finalised and will be delivered in February 2018. The new enhanced running gear concept, bogie design, wheelsets for increased axle weight and track friendliness are being further detailed, and a demonstrator will be built and presented at InnoTrans event in 2018.

The TD concluded the task of selecting and assessing innovative material concepts for lightweight rail vehicle structures. The project INNOWAG shortlisted those materials to be applied on different vehicle structural components and will be used on future design solutions.

During 2017, 2 deliverables were planned in FR8RAIL and INNOWAG out of which 1 was delivered. The overall progress appears to be in line with the plan. Since the beginning, TD5.3 has reported having accomplished 95% of the planned work up to the end 2017.

TDs	TASKS	TRL	2016				2017				2018				2019				2020				2021				2022			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TD 5.3	Name																													
5.3.0	Scanning of innovations	1-2																												
5.3.1	Wagon design	3																												
5.3.2	Running gear	3																												
5.3.3	Definition of components and running gear and wagon manufacturing	4																												
5.3.4	Complete freight wagon demonstrator implementation	5-7																												
	call 2015-2016 projects																													
	planned activities																													

TD5.4 Novel Terminal, Hubs, Marshalling yards, Sidings

This TD has a twofold objective: on the one hand, to provide improved data gathering, steering operation and coordination of intermodal transport with a terminal design that allows efficient change of transport modes; and on the other hand, the hybridisation of the legacy shunting fleet operating in marshalling yards and sidings by means of retrofitting.

TD progress

TD 5.4 Novel Terminal, Hubs, Marshalling Yards, Sidings								
2015	2016	2017	2018	2019	2020	2021	2022	…
		Ongoing: FR8HUB						
			Planned Activities					

This TD builds on the progress made with the project FR8HUB.

The work in this TD started at the end of 2017 with the activities on the intelligent video gate (IVG). The first description of the functional and technical requirements has started as well as the hybridisation of legacy shunters, analysing the state of the art on propulsion system for retrofitting and validating the first built-up hybrid shunting prototype.

During 2017, although the activities are in line with the plan, no technical deliverables were planned in FR8HUB as the project was in its ramp up phase. However, a first requirements workshop was held in November 2017 at the DUSS-Terminal Munich-Riem. The partners received practical information on data requirements, where to detect them and why these data are needed in the terminal operation. The partners gave information on their capabilities in the field of RFID recognition and vehicle detection.

A second workshop in Italy in November 2017 showed the capability of one project partner that has installed a high performance train gate for high speed train detection and wagon profiling as well as safety relevant measures.

The results of the IVG-data requirements and findings will be also used in complementary issues with projects ARCC and OPTIYARD with regards to real time yard and network management from FR8RAIL project in TD5.1.

During 2017, although the activities are in line with the plan, no technical deliverables were planned in FR8HUB as the project was in its ramp up phase.

TDs	TASKS	TRL	2016 Q1	Q2	Q3	Q4	2017 Q1	Q2	Q3	Q4	2018 Q1	Q2	Q3	Q4	2019 Q1	Q2	Q3	Q4	2020 Q1	Q2	Q3	Q4	2021 Q1	Q2	Q3	Q4	2022 Q1	Q2	Q3	Q4
TD 5.4	Name																													
5.4.1	Intelligent Video Gate Terminal	7																												
5.4.2	Hybrid system design & engineering according to specification	7																												

■ call 2015-2016 projects
■ planned activities

TD5.5ʿNew Freight Propulsion Concepts

This TD aims at developing smart and eco-efficient propulsion technologies for last mile, at developing longer coupled trains with distributed power and at improving the overall performance of today's locomotives. These technologies will equip rail freight operators with a higher degree of operational flexibility and stability as well as strengthen the environmental and sustainability advantage of rail freight over other modes of transport.

TD progress

TD 5.5 New Freight Propulsion Concepts								
2015	2016	2017	2018	2019	2020	2021	2022	…
		Ongoing: FFL4E, DYNAFREIGHT, FR8HUB						
				AWP2018: CFM & OC				
					Planned Activities			

This TD builds on the activities performed in the ongoing projects FFL4E, DYNAFREIGHT and FR8HUB. Further activities are planned to start in late 2018 with the projects stemming from the call CFM and OC.

In 2017, the TD advanced on the work in the future freight locomotive, mainly on the bogie design and hybridisation concepts including the integration of energy storage systems as well as the development of a radio remote control for distributed power to allow running trains up to 1500m length (FFL4E project).

The initial work on the locomotives' bogie design focussed on analysing the respective major trends and system architecture for different state of the art of bogies and proposing the three best designs with respect to low wear, noise emission and other various hybridisations concepts. The activity finished with an evaluation report on the best solution for running gear being released at the end 2017. Progressing on this TD topic, DYNAFREIGHT project analysed light materials for bogies and summarised the potential benefits of those materials.

The work has shown that optimisation of the specifications of the design including variations in material thickness, use of higher strength steel and improved weld performance can potentially result in a reduction of up to 43% of the bogie frame mass. The vehicle dynamics studies show that this would translate into a 12.5% reduction in track damage but only a 5% reduction in energy consumption and a 1% reduction in track access charges.

Regarding hybridization of locomotive propulsion system and the implementation of full electric last mile propulsion systems, FFL4E project analysed different transport models based on Li-Ion batteries and hybridization concepts. The TD specified the energy and thermal management concept and the full electric last mile propulsion system demonstrator is currently being developed. It should be presented during the InnoTrans event in 2018. In parallel, technical recommendation for integration, certification and proposal for editing standards are in development. This constitutes the content of deliverables which will be released end of 2018 and beginning of 2019.

The work done on long trains by FFL4E covered a concept paper describing future technology for running double trains and the provision of the relevant specifications. In general, FFL4E aims at establishing solid specifications for technological solutions to enable longer and heavier trains and define technology architecture for that. In parallel, preliminary work from DYNAFREIGHT on long trains has been performed in close cooperation with FFL4E for the functional requirements of radio controlled traction and braking in train configuration and brake application, including safety aspects. DYNAFREIGHT working at solving the remaining technical issues highlighted from the outcome of the FP7 project MARATHON for regular operation for long trains. A workshop on hazard identification was done and a model for long train simulations was completed (braking pneumatics, 1D dynamics and 3D analysis).

During 2017, 10 deliverables were planned in FFL4E, DYNAFREIGHT and FR8HUB out of which 5 were delivered. Considering that some pending deliverables planned for 2017 will officially be released in early 2018 and 2019, it can be said that the delay against plan will be reduced. Since the beginning, TD5.5 has reported having accomplished 60% of the planned work up to the end 2017.

Contracted Activities
Planned Activities

TD5.6 Autonomous train operation

This TD aims at actively pursuing the objective of ATO, progressively realised until 2030, for mainline freight operation and the underlying operations, in order to increase the railway's competitiveness and to achieve operational efficiency gains and optimised resource utilisation.

TD progress

This TD builds on the activities performed in the projects ARCC and SMART; further activities are already planned to start in late 2018 within the project stemming from the call CFM.

The TD activities in 2017 continued with providing an overview of the socio economic situation, legal barriers in Europe (need to obtain technical approval, safety certificate and security permit) and freight specific operational requirements specification for ATO over ETCS(ARCC project). From a quantitative point of view passenger and freight requirements seems to be largely congruent, although their business cases for implementation are quite different. Only about 20% of the functions analysed for Grade of Automation 2 (GoA2) are specific to the passenger sector (urban). Future testing of GoA 2 will generate valuable lessons learnt in order to design the future fall-back scenarios and situation management required for unattended operation under GoA4.

Moreover, ARCC project analysed the relevant parameters affecting energy consumption that make possible to enhance the driving efficiency within rail freight operations between two different timing/stopping points or other references along each ride. The goal was to define concepts, specifications and requirements, in synergy with IP2 projects on ATO, for a generic algorithm to be designed to evaluate energy performances of a running freight train on a specific track and the related parameters to be transferred to the driving system (directly to the driver via Driver Advisory System for GoA1 or to the ATO for higher level of automation) in order to actualize the speed profile.

Furthermore, the TD progressed with SMART project by providing a list of requirements, specifications, in order to develop sensors, passive isolation system and algorithms for an obstacle detection system (ODS) which will be used in the work planned in 2018.

During 2017, 8 deliverables were planned in ARCC and SMART out of which 6 were delivered. The overall progress appears to be slightly below the plan. Since the beginning, TD5.6 has reported having accomplished 80% of the planned work up to the end 2017. One of the reasons is the difficulties encountered for the system integration of technologies coming from IP2.

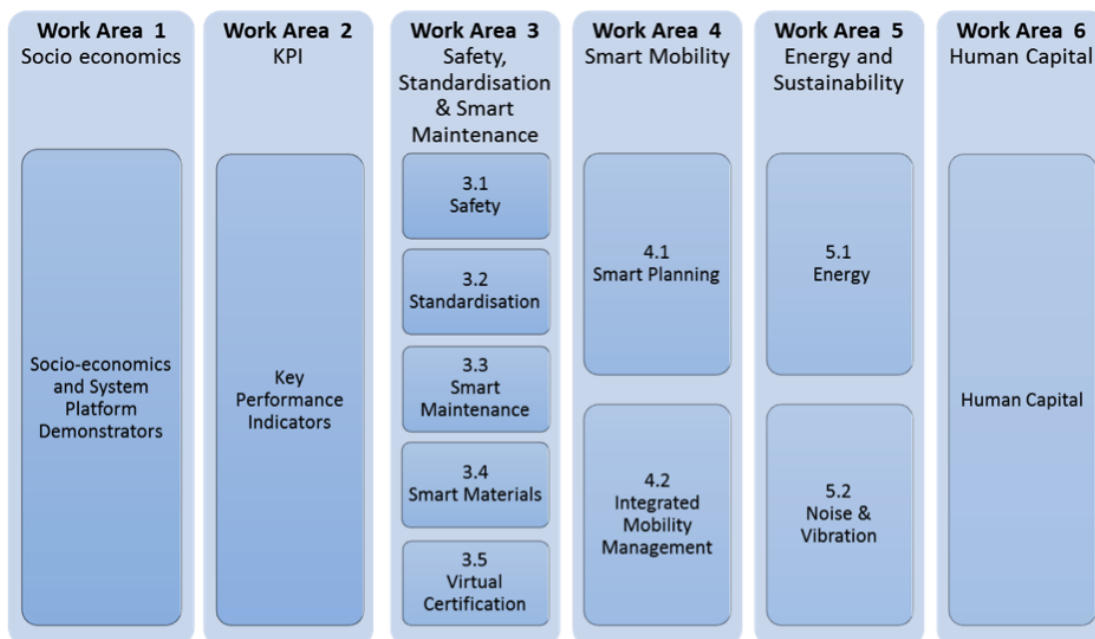| TDs	TASKS	TRL	2016				2017				2018				2019				2020				2021				2022				2023			
TD 5.6	Name		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
5.6.1.1	ATO over ETCS - GOA2 Requirements & Specification analysis	2																																
5.6.1.2	ATO over ETCS - GOA2 Sensor and interfaces development	3																																
5.6.1.3	GOA2 demonstator integration concept and preparation	4																																
5.6.1.4	GOA2 Pilot Line Demonstration	7																																
5.6.2.1	Analyse requirements for real-time data in a DAS-C	3																																
5.6.2.2	Definition of standard interfaces for a DAS-C	3																																
5.6.2.3	Realization and evaluation of first DAS-Cconcept	6																																
5.6.1.5	ATO over ETCS - GOA3/4 Feasibility Study	1																																
5.6.1.6	ATO over ETCS - GOA3/4 Specification	2																																
5.6.2.4	Integration of DAS-C in demonstrator	7																																
5.6.2.5	DAS-C Authorisation & rollout concept	7																																
5.6.1.7	ATO over ETCS - GOA3/4 Product Development	3																																
5.6.1.8	GOA3/4 Reference Test Bench Demonstration	4																																
5.6.1.9	GOA3/4 Pilot Line Demonstration	7																																

1.7.6. CCA Cross Cutting Activities

An overview of the various work areas in the CCAs is shown in the figure below.
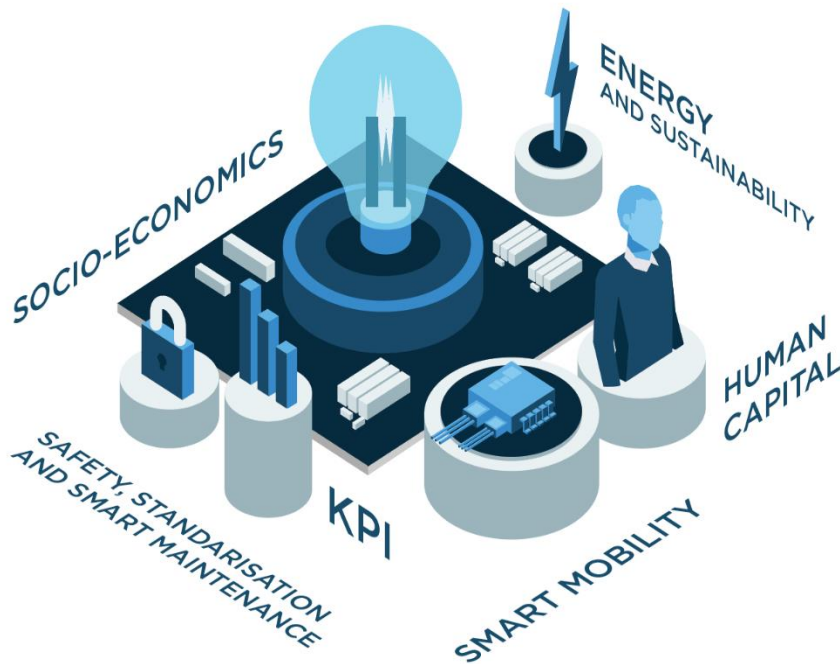
Cross-Cutting Activities are relevant to the different sub-systems of the five IPs taking into account the interactions between these sub-systems.

These cross-cutting activities 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.

CCA work is organised so as to achieve the objectives of the following areas

Work Area 1 Socio economics	Work Area 2 KPI	Work Area 3 Safety, Standardisation & Smart Maintenance	Work Area 4 Smart Mobility	Work Area 5 Energy and Sustainability	Work Area 6 Human Capital
Socio-economics and System Platform Demonstrators	Key Performance Indicators	3.1 Safety 3.2 Standardisation 3.3 Smart Maintenance 3.4 Smart Materials 3.5 Virtual Certification	4.1 Smart Planning 4.2 Integrated Mobility Management	5.1 Energy 5.2 Noise & Vibration	Human Capital

Below a summary of the activities performed in the CCA Work Areas. Activities under WA 3.4 (Smart Materials) and WA 3.5 (Virtual Certification) haven't started yet. The Work Areas on Smart Maintenance (WA3.3), Integrated Mobility Management (WA4.2) and Human Capital (WA6) were launched in September 2017 and these activities are in the initial phase.

WA1 Long-term needs and socio economic research

The objective of WA1 is to analyse the areas and the expected improvements that the works deployed under Shift2Rail bring to the European context in terms of social and economic benefits.

WA1 Long-term needs and socio-economic research & SPD's								
2015	2016	2017	2018	2019	2020	2021	2022	…
Finished: Roll2Rail (Oct. 2017)								
		Ongoing: IMPACT1, NEAR2050, IMPACT2						
				Planned activities				

The topic is addressed in the CFM project IMPACT 1, IMPACT2 and complemented by the OC project NEAR 2050.

Objectives for 2017 were the specification and definition of the long term societal goals to which the rail system is expected to contribute and to develop indicators and methods to be used in assessing the achievement of the goals. The work includes analysis of short and long terms trends expected to effect the railway sector and identification of key factors for the development of a successful railway system. Reports are due in February 2018.

A further objective of 2017 was to develop requirements and properties for the four S2R System Platform Demonstrators (SPDs) high-speed passenger rail, regional passenger rail, urban passenger rail and rail freight. The SPDs serve as a common base for the KPI modelling, mode choice modelling and socio-economic analysis. The requirements and properties of the SPDs were defined and delivered in 2017. Drafted use cases for each market segment were developed in close collaboration with the IMPACT-1 partners, and is planned to be reviewed and validated by the Shift2Rail Members. In addition, the modelling approach for the mode choice analysis is under development.

During 2017, 10 deliverables were planned in NEAR2050 and IMPACT-1 , all were released. The overall progress appears to be in line with the plan. Since the beginning, WA1 has reported having accomplished 95% of the planned work up to the end 2017.

WA	TASKS	TRL	2016				2017				2018				2019				2020				2021				2022			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
WA 1	Long-term needs and socio-economic research	-																												
WA1.1.1	Societal needs analysis	-																												
WA1.1.2	Influences to 2025, 2035, 2050 from Mega-Trends...	-																												
WA1.1.3	Societal development by transportation	-																												
WA1.1.4	Key success factors for a successful railway system	-																												
WA1.1.5	Rail Transport Governance	-																												
WA1.1.6	Shift2Rail Societal Effects	-																												
WA1.1.7	Rail as a design tool in societal development	-																												
	call 2015-2016 projects																													
	planned activities																													

WA 2 –KPI (Key Performance Indicators) method development and integrated assessment

The objectives of the Work Area 2 are to capture the impacts of the TDs and to assess how they contribute to the key S2R targets by defining and quantifying measures for their results.

WA progress

The main objectives for 2017 were to define the "Interface KPI" (sublevel KPIs between the TD and the overall KPI assessment) as well as the S2R reference scenarios and to set up the system structure as the qualitative KPI model. The reference scenarios are the detailed parameters of the SPDs defined in Work Area 1.2.

WA2 KPI method and integrated assessment								
2015	2016	2017	2018	2019	2020	2021	2022	…
Finished: Roll2Rail (Oct. 2017)								
		Ongoing: IMPACT1, tender KPIs, IMPACT2						

This WA builds upon the following projects: ROLL2RAIL (LP), IMPACT-1, IMPACT-2 and a tender focused on the support for KPIs development.

In 2017, the S2R JU launched a series of important mitigation measures, including decisions from the S2R GB, in order to address the very slow initial setup of this work area and the encountered difficulties by both, the tender and the IMPACT-1 in gathering all necessary information from the S2R TDs.

An initial model was set up by the consortium working on the tender "Long-term needs & socio-economic research" and an initial estimation was performed.

The resulting model has been used as input to the ongoing mitigation applied measures and work, identifying the three KPI models, each of them addressing one of the top level KPI: capacity, punctuality and life cycle costs. A new KPI management setup was established directly by the S2R JU in order compensate the internal resources issues of the project and the difficulties to collect technical inputs from the TD and to agree on the specific sub-system that would fit into the models.

The integration of the three High level KPI models and the consideration of interdependencies within as well as in between the models will be done as the following step. The currently developed tool is based on Excel as an early prototype to evaluate requirements on the later tool.

To compensate the delay encountered in the first half of 2017, the S2R JU has provided significant internal resources efforts to allow an acceleration of the activities, in particular to be able to provide an early KPI framework. A restructuring of the task in the work area was carried out with an acceleration of the quantification and mathematical formulas for the first planned delivery by early 2018.

During 2017, 2 deliverables were planned in the above mentioned tender out of which all were released. Since the beginning, WA2 has reported having accomplished 80% of the planned work up to the end 2017.

WA	TASKS	TRL	2016				2017				2018				2019				2020				2021				2022			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
WA2	KPI method development and integrated assessment																													
WA2.0.1	Reference Scenario	-																												
WA2.0.2	Subsystem Structure	-																												
WA2.0.3	Sublevel KPIs	-																												
WA2.0.4	Tool specification and development	-																												
WA2.0.5	Validation	-																												
WA2.0.6	Monitoring	-																												
	lighthouse projects																													
	call 2015-2016 projects																													
	planned activities																													

WA 3 Safety, Standardisation and Smart Maintenance

Work Area 3 builds on the activities of the projects Plasa, GoSAFE RAIL, IMPACT2 and SMaRTE, the graph below refers to all the activities performed in the whole WA. At the end of 2017 the WAs 3.4 (Smart Materials) and 3.5 (Virtual Certification) have not started yet while the WA 3.3 (Smart Maintenance) started in September and is in an initial status.

WA3 Safety, Standardisation, Maintanance, Materials, Virtual Certification								
2015	2016	2017	2018	2019	2020	2021	2022	…
		Ongoing: PLASA, GoSAFE RAIL, IMPACT2, SMaRTE						
			AWP 2018: CFM					
					Planned activities			

WA 3.1 – Safety

The objective of WA3.1 is to develop a global approach of the safety of the railway system. This global approach is based on a global risk assessment model and aims at providing key results to manage the safety level of the existing railway system and to evaluate the safety improvements carried out in the S2R TDs.

The objective for 2017 was to finalize the state of the art of the risk assessment methods (WA3.1.1) and to define the requirements to develop a global risk assessment study, i.e. encompassing the actual complexity of the railway system (WA3.1.2).

Currently, within Shift2Rail, the work area safety is addressed in the CFM project PLASA and the complementary Open Call project GoSafeRail, in a 3years' timeframe (Sept2016-Aug2019).
In PLASA, an extensive research has been carried out on the state of the art methods and tools to assess the risk in different domains. In particular a list of approaches on risk assessment have been analysed, while an inventory of the basic technics has been reviewed to evaluate the safety. A selection of the major safety parameters has also been performed to implement in a S2R model for safety decision-makers. In parallel, in the Open Call project GoSafeRail, global rail safety indicators have been defined, allowing the quantification of safety improvements induced by S2R innovations in the future. Developments and practical implementations of infrastructure monitoring systems are under progress considering usage of monitoring data, survey of events, selection of sites, etc.

During 2017, 6 deliverables were planned in PLASA and GoSafe Rail out of which all were released. The overall progress appears to be in line with the plan. It can be concluded that overall, at the end of 2017, 90% of the planned work can be considered as completed.

WA	TASKS	TRL	2016				2017				2018				2019				2020				2021				2022			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
WA3.1	**Safety**																													
WA3.1.1	State of the art of risk assessment methods	2																												
WA3.1.2	Requirements to conduct a risk assessment study	2																												
WA3.1.3	Requirements to apply the risk assessment method	2																												
	call 2015-2016 projects																													
	planned activities																													

WA 3.2 – Standardization

The main objective of WA3.2 is to foster the transfer of Shift2Rail results and outcomes of innovation activities into standards or regulatory documents when needed and beneficial. It aims to provide a coordinated approach across the Shift2Rail research activities and to develop optimised pre-standardisation aligned processes with the relevant standardisation bodies, standard setting organisations, as well as ERA.
The Standardisation work area is covered IMPACT-2 CFM project started in September 2017. Considering the importance of such work area, the S2R JU decided to launch with its Members preparatory activities already in the beginning of 2017.

The objective for 2017 was to assess the standardisation potentials and to scrutinize the expected outcomes of the different S2R TDs. Based on this input, the WA is currently setting up a high level standardisation roadmap, gathering the potential needs and opportunities for standardisation.

A benchmark was done in 2017 looking at comparable research initiatives from other technical domains. A S2R standardisation questionnaire was set up to collect the necessary data from each TD in order to populate the roadmap and identify the standardisation needs and opportunities.

At the end of 2017, the realised work can be estimated as exceeding the original plan due to the early start of the activities. No deliverables were planned for 2017.

Nonetheless, information collection has been proven to be a challenge, in particular for the coordination with the TD experts and the human resources effort needed for the TD input.

WA	TASKS	TRL	2016				2017				2018				2019				2020				2021				2022			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
WA3.2	**Standardisation**																													
WA3.2.1	Strategic analysis of the Shift2Rail activities in terms of standardisation and regulation	-																												
WA3.2.2	Definition of the S2R organisation managing standardisation and regulation (TSI) matters	-																												
WA3.2.3	Benchmark of existing organisation and processes towards innovative standardisation	-																												
WA3.2.4	Establishment of the Shift2Rail internal standardisation processes	-																												
WA3.2.5	Transfer of the Shift2rail inputs to standards	-																												
WA3.2.6	Management of Shift2Rail results and regulation (TSIs and open points)	-																												
	activity without project funding																													
	planned activities																													

Work Area 4 SMART MOBILITY

The WA 4.2 (Integrated Mobility Management) has started its activity in September and is therefore at the very initial phase of its work

Work Area 4.1 –Smart Planning

The aim of Smart Planning is to enable railway stakeholders to make the best decisions for the overall system, for example concerning schedules and the availability of rolling stock and staff, based on up-to-date operational data, taking into account all essential information in order to ensure

quality promised is delivered to customers. The task also enables optimum allocation of funds by using knowledge of all relevant system parameters and their interaction to promote the best possible use of existing capacities.

WA4 Smart Planning, I2M								
2015	2016	2017	2018	2019	2020	2021	2022	…
Ongoing: IN2RAIL, PLASA, GoSAFE RAIL, IMPACT2								
			AWP 2018: CFM					
					Planned activities			

This work area is addressed in the CFM project PLASA and the complementary Open Call project GoSafeRail. The plan for 2017 was first of all, the establishment of the project design and integration.

The other major objective was to start with different railway planning activities and basic model development. This meant to lay the fundamentals for an enhanced integrated micro-level railway simulation system including first development steps concerning impact of disturbances on railway operation.

In addition, the CFM project, Plasa carried out a development of a basic model prototype to proof of operability of the simulation approach.

During 2017, 5 deliverables were planned in PLASA and GoSafe Rail out of which 4 were released. The work planned for 2017 has been achieved, the milestone has been reached as planned and the progress appears to be exactly as planned so far with an estimation of 95%.

WA	TASKS	TRL	2016	2017	2018	2019	2020	2021	2022
WA4.1	**Smart Planning**								
WA4.1.1	Project design and integration	-							
WA4.1.2	Railway planning activities and basic model development	5							
WA4.1.3	Model refinement and strategic planning	6/7							
	call 2015-2016 projects								
	planned activities								

Work Area 5 Energy and Sustainability

Work Area 5 builds on the results of the ROLL2RAIL (LP) and on the activities of the projects FINE 1 OPEUS and DESTINATE, the graph below refers to all the activities performed in the whole WA.

WA5 Energy and sustainability								
2015	2016	2017	2018	2019	2020	2021	2022	…
Finished: Roll2Rail (Oct. 17)								
	Ongoing: FINE1, OPEUS, DESTINATE							
					Planned activities			

WA 5.1 Energy

The overall objective of this work area is to develop standardised methodology for estimation of energy consumption by simulation and measurement enabling the standardised specification of energy efficient railway systems.

The Energy work area is covered in the CFM project, FINE1 and in the OC project OPEUS.

During 2017, FINE1 defined the Energy-relevant TDs within the S2R Programme by means of an analysis and an informal query among the energy experts of the TD leaders' companies. The S2R CCA Energy expert network was set up and it held quarterly meetings with FINE1, TD-representatives and OPEUS. The KPI gathering process was aligned, especially with IMPACT-1 and PINTA. Furthermore, energy sub-level KPIs were defined and aligned with TDs. The energy baseline was examined extensively, assuring the reference vehicle parameters are representative for state-of-the-art European railway rolling stock.

In 2017, OPEUS has focused on defining, developing and validating a simulation tool and associated methodology for the assessment of energy implications of introducing innovation in rolling stock. In addition, a number of reference scenarios largely based on the prEN50591 standard "Specification and verification of energy consumption for railway rolling stock" as well as inputs from the results of the ROLL2RAIL (LP). In addition, work has been carried out assisting the scope of the potential impact on energy consumption by using DAS, a characterisation of vehicle traction architecture and an outlook on battery storage technologies.

A close and fruitful cooperation with FINE1 and OPEUS have been developed, which is essential for the development and validation of the energy simulation tool as well as the definition of the reference scenarios.

During 2017, 8 deliverables were planned in FINE1 and OPEUS out of which 6 were released. The overall progress appears to be in line with the plan. It can be concluded that overall, at the end of 2017, 80% of the planned work can be considered as completed.

WA	TASKS	TRL	2016				2017				2018				2019				2020				2021				2022			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
WA 5.1	Energy and Sustainability																													
WA5.1.1	Interface with other S2R groups	-																												
WA5.1.2	Energy calculation methodology	-																												
WA5.1.3	Assessment of energy improvement	-																												

	lighthouse projects
	call 2015-2016 projects
	planned activities

WA 5.2 – Noise and Vibration

The overall objective of this work area is to reduce the annoyance and exposure to noise and vibration related to the railway sector in Europe and to provide the necessary system approach and leverage the results from all the IPs by applying effective noise control in the different technical demonstrators.

The Noise and Vibration work area is covered in the CFM project, FINE1 and in the OC project DESTINATE.

The CFM project, FINE1 had to face a challenge to align with the OC project DESTINATE on their own technical objectives which resulted a slow start-up of the project and still couldn't recuperate from this delay. During 2017, FINE 1 was able to identify the S2R TDs relevant for the noise and vibration aspects and reviewed the state of the art for industrial interior noise prediction methods used by the partners and by other industrial sectors.

In 2017, DESTINATE has focused on providing an overview of railway noise generation, assessing the relevance of different railway noise sources for interior and exterior noise and defined mitigation options. Methods to account for human perception of noise have been analysed with regard to their

applicability for railway noise. In addition, auralisation and visualisation models for freight and passenger trains have been developed.

After necessary alignment of the FINE1 and DESTINATE projects' scope, the collaboration between the two projects was agreed and as a joint effort, traffic scenarios and a common approach for cost-benefit analysis were defined.

During 2017, 7 deliverables were planned in FINE1 and DESTINATE out of which 4 were released. The overall progress appears to be behind the original plans. It can be concluded that overall, at the end of 2017, 65% of the planned work can be considered as completed.

WA	TASKS	TRL	2016 Q1 Q2 Q3 Q4	2017 Q1 Q2 Q3 Q4	2018 Q1 Q2 Q3 Q4	2019 Q1 Q2 Q3 Q4	2020 Q1 Q2 Q3 Q4	2021 Q1 Q2 Q3 Q4	2022 Q1 Q2 Q3 Q4
WA5,2	**Noise and Vibration**								
WA5.2.1	Technical assessment and integration on system level	-							
WA5.2.2	Evaluation and monitoring of impact on traffic noise scenarios	-							
WA5.2.3	Exterior noise simulation model and separation	-							
WA5.2.4	Interior noise simulation model	-							
WA5.2.5	Ground Borne Vibration Prediction Methods	-							
WA5.2.6	Sources and sub-assemblies characterisation methods	-							
WA5.2.7	New methodologies and technologies	-							
	call 2015-2016 projects								
	planned activities								

1.8. Calls for tenders

Overall, with regard to the implementation of Procurement activities, the S2R JU has complied with the European Commission Procurement Vademecum and the principles of its financial rules. This resulted in being able to implement activities obtaining the best value for money compared to other similar programmes, for example in the case of the in the tool supporting the S2R Programme.

The values established for the different procurement procedures, which in any case are below any materiality level considering the total value of the R&I activities and the Programme, result from the collective knowledge of the staff involved in it and their experience in previous private and public organizations.[16]

The S2R JU published the following open calls for tenders in 2017:

S2R.17.OP.01 Provision of strategic communications, editorial support, graphical, digital and events-related communications services

The objective of this tender was to provide the S2R JU with external support related to strategic communications, editorial support and graphic design, digital communications and events as well as to web hosting and maintenance.

The tender was divided into 4 (four) lots aimed at concluding a maximum of 4 (four) framework contracts. The contract notice was published in EU Official Journal on 03/02/2017.

Following the evaluation of the tenders received the contracts were awarded to:

Lot No: 1 - 20 Seconds to Midnight

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[16] Also in answer to point 15 of Discharge 2016 of EP, reference P8_TA-PROV(2018)0173.

- Contracts signed on 30/06/2017
- Maximum total contract value (4 years duration): EUR 300.000

Lot No: 2 - 20 Seconds to Midnight in consortia with Methods S.A and Cecoforma SA
- Contract signed on 30/06/2017
- Maximum total contract value (4 years duration): EUR 200.000

Lot No: 3 - Ecorys Brussels N.V
- Contract signed on 07/09/2017
- Maximum total contract value (4 years duration): EUR 500.000

Lot No: 4 – not awarded. The S2R JU decided to abandon the procurement procedure due to the fact that the solutions proposed for Lots 1 & 2 allowed for a considerable reduction of scope of its web hosting and website maintenance needs. It was not possible to foresee upfront the risk of overlap between Lot4 and the others due to the fact that different solutions could be suitable to implement digital communication activities. Nevertheless, in accordance with sound financial management the S2R JU maximized its results abandoning Lot4.

S2R.2017.OP.02: Pantograph – Overhead Contact Line Interaction – Dynamic Behaviour and Quality of the Current Collection –

- Prior information notice published in EU Official Journal : 07/04/2017
- Contract notice published in EU Official Journal : 12/09/2017
- Contract value: EUR 0.7 million (12 months duration)

S2R.2017.OP.04: Support to the ERTMS Deployment action as baseline for Shift2Rail (IP2) innovative solutions

- Contract notice published in EU Official Journal : 16/12/2017
- Framework Contract with maximum total value: EUR 8 million for a maximum duration of 4 years

S2R. LVC.17.03   S2R office and staff supplies

- Call for expressions of interests to participate in a negotiated procedure for a low value contract not exceeding EUR 60 000

Former procedure **S2R.2016.OP.02** (Cross-cutting activities: Human Capital) was terminated without award. A new negotiated procedure involving the economic operators which took part in the initial call was launched in 2017 and the contract awarded in Dec 2017 to TNO (Netherlands Organisation for Applied Scientific Research) in consortia with University of Newcastle upon Tyne. The value of the contract is EUR 0.2 million (15 months duration).

1.9.   Dissemination and information about projects results

The S2R JU aims at the dissemination of its innovative Programme results achieved through the current and future Projects. The dissemination activities are particularly addressed towards the

European scientific and academic community but not only. They play a pivotal role within the S2R Programme and are at the base of its success.

The dissemination activities start with the concept of building the S2R JU as a platform for R&I in the railway sector, where all interested parties may found and exchange as necessary. The S2R JU website hosts the specific CFM Projects activities and connects to the OC Project websites and disseminations activities, as well as the Lighthouse Projects and other similar (See also section 2.1).

The S2R JU has encouraged the projects that contributes to the same Innovation Programme to investigate the possibility to have common dissemination events. This has been successfully implemented by IP3 Projects IN2SMART, IN2TRACK and S-CODE which held a joint mid-term conference in January 2018.

In addition the S2R JU exhorted all its projects to make use of the new "*Common Dissemination Booster*" tool made available by the EC Common Support Centre (RTD, Unit J.5).

The S2R projects IMPACT-2, FR8RAIL, FR8HUB and IN2TRACK clustered in a project group and requested to make use of this pilot dissemination service for:
- Service 2: Stakeholder/End-User mapping
- Service 3: Portfolio Dissemination Plan Development
- Service 4: Portfolio Dissemination Capacity Building
- Service 5: Dissemination Campaign in Practice.

1.10. Operational budget execution

The S2R GB adopted the AWP 2017 on 9 November 2016 and its amendment n° 2 to the budgetary figures on 27 October 2017.

The amended Budget corresponded to the specific needs of the JU, including transfers within the initially adopted budget, recognising the unused Payment and Commitment Appropriations on administrative and operational expenditure in relation to the previous budgetary years and the move of expert expenses on Call evaluations from the administrative to operational line.

The Budget amendment also cancelled the payment appropriations assigned for the S2R Lighthouse Projects. Since the initial planning of the budget, it had been decided that these projects would remain under the administration of the European Commission. The appropriations were not collected by the JU at any point in time.

In accordance with the S2R Financial Rules Art.6§5, the S2R JU has established in its Budget Title 4: Un-used Appropriations not required in the year. This Title is of technical nature and recognises the appropriations available for applying n+3 rule on the following budgetary years.

In addition to the transfers made towards Title 4 as part of the budget amendment, the Executive Director has exercised its rights in Accordance with Article 10 of the S2R Financial Rules by transferring appropriations from Title 2 to Title 4. This action has been implemented as response to the multiannual budgetary planning of the JU. The JU has ability to reactivate credits from Title 4 in the following budgetary year. This reactivation will be implemented as part of budget amendment in 2018.

In terms of Commitment Appropriations, Title 3, the Operational budget, represents 89.0% of the overall S2R 2017 Budget. The execution rate of the Operational budget in both Commitment and Payment Appropriations was respectively 100% and 84.2%. The Payment appropriation were mostly used for the pre-financing of the Grants resulting from the 2017 Call for Proposals, for a total amount of EUR 28.0 million.

1.11. In-Kind Contributions

In accordance with article 4(3) of the S2R Regulation, "t*he members of the S2R Joint Undertaking other than the Union shall report by 31 January each year to the Governing Board of the S2R JU on the value of the contributions referred to in paragraph 2 made in each of the previous financial years*".

Article 4(2) of the S2R Regulation establishes that the total contribution to be provided by the Other Members[17] and totalling EUR 470 million shall consist of:

- *IKOP*[18] *(in-kind operational)*: at least EUR 350 million, including at least EUR 200 million from the founding members other than the Union and their affiliated entities, and at least EUR 150 million from Associated Members and their affiliated entities. In accordance with Article 16(3)b of the S2R Statutes, IKOP consists "*of the costs incurred by them [the Other Members] in implementing indirect actions less the contribution of the S2RJU and any other Union contribution to those costs*".

- *IKAA (in-kind other activities)*: at least EUR 120 million, of which at least EUR 70 million from the Founding Members other than the Union and their affiliated entities, and at least EUR 50 million from Associated Members and their affiliated entities. These contributions shall consist of the costs incurred by them in implementing additional activities outside the work plan of the S2R Joint Undertaking, which are complementary to this work plan and contribute to the objectives of the S2R Master Plan. Other Union funding programmes may support those costs in compliance with the applicable rules and procedures. In such cases, Union financing shall not substitute for the in-kind contributions from the members other than the Union or their affiliated entities.

The aforementioned In-Kind Contributions are in addition to the cash contribution of the Other Members to the 50% of the administrative costs of the JU.

Other Members' reporting for 2017

The Other Members of S2R submitted their reporting on IKOP and IKAA to the JU by 31 January 2018. The JU requested that the Members perform an additional verification of the submitted figures, and some of them provided an updated reporting by 19 February 2018.

As in 2017, the Lighthouse Projects are excluded from this reporting as they are assimilated into open calls and within the administrative management of the European Commission.

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[17] The "Other Members" are defined as the Founding Members of the JU, with the exclusion of the Union, and the Associated Members.

[18] As laid down in Article 16(2) and Article 16(3)(b) of the Statutes.

This second report covers the R&I activities performed in 2017. The cumulative figures include all of the S2R JU R&I activities as from the start of the Programme on 1 September 2016. Nevertheless, it should be noted that, in terms of IKAA, the activities are considered eligible as from the date of acceptance by the Other Members of the S2R JU Statutes by means of their respective letters of endorsement.

In accordance with Article 4(4) of the S2R Regulation, the Other Members shall have the costs related to IKOP and IKAA certified by an independent external auditor appointed by the entity concerned.

IKOP and IKAA Certification

By 30 April 2017, the Other Members have provided the JU with audit certificates on the Total Project Costs (and consequently IKOP) and IKAA costs declared for the year 2016. The corresponding IKOP contributions have been "validated" by the Executive Director in 2017. They will therefore be accounted towards the obligation set in Article 4(2) of S2R Regulation to the Other Members as well as recorded as Net Assets of the Joint Undertaking in the Annual Accounts 2017.

By the deadline of 31 January 2018, none of the Other Members was in the position to have its costs related to 2017 IKOP and IKAA certified. Nonetheless, this is in line with the Commission position communicated officially in July 2016, which clarifies that the certification of costs (based on which IKOP is calculated) should be annual, and it should be transmitted to the relevant JU by its members by 30 April. This is also essential for the preparation of the Annual Accounts of the JU and the JU's reporting.

With regard to the Final Annual Accounts of S2R JU, all IKOP contributions reported but not validated in 2017 will be accounted for as "to be validated" considering that:

- 87.5% of the IKOP reported is supported by the certification
- the validation of IKOP by the JU will be performed once the respective project cost statements, submitted in end of February 2018, are validated

On 1 June 2018, based on the audit certificates received and the Projects' cost statements, the situation of IKOP and IKAA is as following:

	IKOP REPORTING											
	TOTAL PROJECT COST				CO-FUNDING			IKOP				
Other Members	**AAR 2016**	**AAR 2017**	**TOTAL**	**of which CERTIFIED**	**AAR 2016**	**2017 estimates**	**TOTAL**	**AAR 2016**	**2017**	**TOTAL**	**Validated as Net Assets in 2017**	**To be validated**
Alstom(*)	543,145	7,016,298	7,559,443	7,559,443	264,949	2,933,039	3,197,987	278,197	4,083,259	4,361,456	-	4,361,456
Ansaldo STS	913,614	4,307,792	5,221,406	5,221,406	406,010	1,915,364	2,321,374	507,604	2,392,429	2,900,033	507,604	2,392,429
Bombardier Transportation	497,678	3,701,395	4,199,073	3,701,395	305,278	1,531,364	1,836,642	192,400	2,170,030	2,362,430	-	2,141,545
CAF(*)	750,538	5,028,851	5,779,389	5,746,636	311,613	2,391,767	2,703,380	438,924	2,637,084	3,076,008	423,699	2,634,119
Network Rail(*)	213,738	1,003,663	1,217,401	880,574	92,474	449,794	542,269	121,264	553,869	675,133	-	485,480
Siemens(*)	531,552	4,413,246	4,944,798	4,944,798	226,665	1,923,036	2,149,701	304,887	2,490,210	2,795,097	304,887	2,490,210
Thales(*)	352,585	2,552,406	2,904,992	2,307,668	163,344	1,075,894	1,239,238	189,241	1,476,512	1,665,753	98,980	1,221,164
Trafikverket	596,641	4,074,404	4,671,044	3,592,653	212,093	931,282	1,143,375	384,548	3,143,121	3,527,669	-	2,714,101
Founding Members	4,399,491	32,098,055	36,497,546	33,954,572	1,982,426	13,151,541	15,133,967	2,417,064	18,946,515	21,363,579	1,335,170	18,440,504
Aerfitec	-	192,774	192,774	-	-	85,669	85,669	-	107,105	107,105	-	-
Amadeus	2,256	9,400	11,656	-	1,579	4,177	5,756	677	5,223	5,899	-	-
AZD Praha	80,294	532,278	612,573	612,573	35,683	230,008	265,691	44,612	302,271	346,882	44,612	302,271
Competitive Freight Wagon	220,681	959,315	1,179,995	-	98,073	426,324	524,397	122,608	532,990	655,598	-	-
Deutsche Bahn AG	1,265,005	5,028,020	6,293,025	6,293,025	351,627	1,783,196	2,134,823	913,378	3,244,824	4,158,201	913,378	3,244,824
Diginext(*)	116,281	809,823	926,104	926,104	51,675	359,885	411,561	64,606	449,938	514,543	-	514,543
EUROC	57,805	157,720	215,525	-	17,554	54,985	72,539	40,251	102,736	142,987	-	-
Faiveley	328,322	1,324,394	1,652,716	1,625,993	120,477	588,162	708,639	207,845	736,232	944,077	207,845	721,384
Hacon(*)	237,191	1,374,046	1,611,237	1,611,237	105,763	608,268	714,031	131,428	765,778	897,206	131,428	765,778
Indra(*)	244,161	2,192,480	2,436,641	2,436,641	108,464	996,631	1,105,095	135,697	1,195,849	1,331,546	135,697	1,195,849
Kapsch	83,908	1,073,368	1,157,276	1,157,276	37,289	477,005	514,294	46,619	596,363	642,982	46,619	596,363
KnorrBremse	92,533	569,071	661,604	661,604	41,122	252,895	294,017	51,411	316,176	367,587	-	367,587
MerMec(*)	93,049	506,010	599,059	599,059	41,412	224,836	266,248	51,637	281,174	332,811	51,637	281,174
SmartDeMain	60,256	1,364,846	1,425,102	430,767	27,621	544,637	572,257	32,635	820,210	852,845	16,433	221,912
SmartRaCon	118,744	959,237	1,077,981	-	47,449	395,844	443,293	71,295	563,393	634,688	-	-
SNCF(*)	111,737	849,976	961,713	849,976	50,742	375,366	426,109	60,995	474,610	535,605	-	474,610
SWITRACKEN	23,502	183,131	206,633	10,322	12,977	82,466	95,444	10,524	100,665	111,189	5,742	-
Talgo(*)	8,937	217,297	226,234	226,234	3,972	96,567	100,538	4,966	120,730	125,696	-	125,696
Virtual Vehicle Austria Consortium VVAC	304,876	1,220,404	1,525,280	1,412,071	137,365	542,855	680,221	167,510	677,549	845,059	121,253	660,342
Associated Members	3,449,537	19,523,592	22,973,128	18,852,883	1,290,844	8,129,776	9,420,621	2,158,692	11,393,815	13,552,508	1,674,643	9,472,334
Total	7,849,027	51,621,647	59,470,674	52,807,455	3,273,271	21,281,317	24,554,588	4,575,756	30,340,330	34,916,086	3,009,813	27,912,838
Of which certified	5,988,984	46,818,471		52,807,455								

Other Members	IKAA			
	In-Kind Additional Activities as at 1 June 2017	In-Kind Additional Activities as at 1 June 2018	TOTAL	of which Certified as a 1 June 2018
Alstom	-	11,912,418	11,912,418	11,912,418
Ansaldo STS	253,146	1,227,274	1,480,421	1,480,421
Bombardier Transportation	6,635,077	9,053,091	15,688,168	9,053,091
CAF	5,451,319	3,494,977	8,946,296	8,946,296
Network Rail	1,520,477	565,000	2,085,477	-
Siemens	5,000,000	1,500,000	6,500,000	6,500,000
Thales	2,153,518	2,267,476	4,420,995	4,420,995
Trafikverket	7,857,021	17,302,291	25,159,312	-
Founding Members	28,870,558	47,322,528	76,193,086	42,313,221
Aerfitec	-	503,836	503,836	-
Amadeus	-	2,750,000	2,750,000	-
AZD Praha	304,439	385,221	689,659	689,659
Competitive Freight Wagon	165,421	230,542	395,963	-
Deutsche Bahn AG	11,276,093	8,082,936	19,359,030	19,359,030
Diginext	280,000	260,000	540,000	260,000
EUROC	1,192,513	933,728	2,126,240	-
Faiveley - Wabtec	2,871,825	1,009,486	3,881,311	3,881,311
Hacon	1,776,809	1,872,754	3,649,563	3,649,563
Indra	1,530,492	157,800	1,688,292	1,594,292
Kapsch	483,117	748,228	1,231,345	1,231,345
KnorrBremse	1,366,435	3,425,536	4,791,972	4,791,972
MerMec	456,040	520,205	976,244	976,244
SmartDeMain	1,073,142	1,677,347	2,750,490	1,180,007
SmartRaCon	255,938	292,058	547,996	-
SNCF	530,218	404,414	934,632	-
SWITRACKEN	187,461	8,132	195,592	2,461
Talgo	422,786	1,387,976	1,810,762	1,810,762
Virtual Vehicle Austria Consortium VVAC+	1,978,369	3,050,007	5,028,375	4,545,264
Associated Members	26,151,097	27,700,206	53,851,303	43,971,909
Total	55,021,655	75,022,734	130,044,389	86,285,130

IKOP

This 2017 IKOP report by the Other Members confirms a positive trend in line with the usual Programme Management S-Curve.

As indicated under the definition of IKOP, these costs represent the difference between the Total Project Value and the S2R JU co-funding (or estimated).

The 2017 IKOP is the result of the 2017 activities performed by the Other Members, resulting from the grants awarded since the beginning of the autonomous JU activities in 2016:

EUR million	R&I activities			%
	awarded	realized		
	Sept 16 - Dec 17	2017	Sept 16 - Dec 17	
Total Value	233.8	51.6	59.5	25.4%
S2R co-funding	103.9	21.3	24.6	23.6%
IKOP	129.9	30.3	34.9	26.9%

In order to allow the S2R JU to be in the position to sign the relevant grant agreements, the Union provided the necessary Commitment Appropriations to match the S2R co-funding of EUR 103.9 million above (excluding OC), against the Other Members' commitment of EUR 233.8 million. In terms of Union Payment Appropriations, they were used to provide the pre-financing up to 45% of the estimated co-funding in accordance with the relevant provisions of the grant agreements.

It should be noted that the estimated requested co-funding included in the 2017 Other Members' declarations is foreseen to remain within the provision of the relevant Membership Agreements. In fact, Article 2.2 of each Other Member's Membership Agreement signed with the S2R JU establishes that "*the Member agrees to limit its reimbursement request in each indirect action funded under Article 3.1(a) of the S2R JU Regulation to an amount not exceeding 44.44% of the Member's total costs in implementing that indirect action. The minimum financial contribution to the S2R JU referred to in Article 4.2(a) of the S2R JU Regulation shall thus be respected*".

The percentage resulting from the accumulative declarations in 2017 is 41.3%, within the maximum level of 44.44%. It is expected that by the end of each Grant, the overall percentage will be aligned to 44.44% for all Other Members.

IKAA

In terms of IKAA, the total expected contribution by the end of the S2R Programme is estimated to be above the minimum amount of EUR 120 million, established in accordance with the S2R Regulation. By the end of 2017, **the cumulative IKAA declared by the Other Members already amounts to EUR 130.0 million, corresponding already to 108.3% of the total estimated value. Out of this amount, EUR 86.3 million were already certified.**

1.12. Synergies with the Union Programmes/ Funds and national funded R&I

During the first months since its autonomy, the S2R JU started some activities and participated to Regional events organized by the Committee of the Regions and European Economic and Social Committee to consider how to make use of activities planned in other Union Programmes and Funds in relation with the Railway sector, in particular EFSI, Regional and Cohesion Fund. This work stream will further develop during 2018.

In terms of national funded R&I activities in the Railway sector, the S2R JU invites the relevant MS to present their programmes and projects in the context of the meetings of the SRG. This allows discussion on way to interconnect the different activities and ensure that resources are leveraged for the best results. This is an ongoing process and it is becoming more and more relevant in view of standardization processes and market uptake.

In this respect, with the support of the Chair of the SRG, the S2R JU has started discussions with the SEESARI initiative (South East Europe Strategic Alliance for Rail Innovation) in view of the establishment of an MoU for collaboration in R&I, future demonstrations and deployment. Similarly, the S2R JU started contacts with the Rail Baltica Project covering the Baltic States and Poland: the objective is to ensure that rail R&I and, in particular, S2R innovative solutions are embedded in new rail projects.

Recently, the S2R JU entered in discussion with the "Stairways to Excellence" a European Parliament Pilot Project executed by DG-JRC together with DG-REGIO. The project aims to support EU28 countries and regions in developing and exploiting the synergies between European Structural and Investment Funds (ESIF), Horizon 2020 (H2020) and other EU funding programmes. This should create more opportunities for the regions/countries to obtain funding apart from only H2020, with the objective to increase innovation potential and implement efficiently innovative solutions.

1.13. Launch of 2018 Calls for Proposals and Tenders

In December 2016, the S2R JU started the process for the preparation of the 2018 Call that was finally published on 12 Jan 2018; the original version of the AWP 2018 was published on 27 Oct 2017. This lengthy process includes the key contribution of the S2R Members, the review and advice at different points of the SC, SRG, ERA and UR-ID and the adoption of the S2R GB, after the overall work was finalized under the responsibility of the Executive Director.

Since its appointment, the Executive Director was requested by the Members to ensure the streamline of the S2R Programme, starting with its administration. The Executive Director, together with the Programme Office, looked at the simplification process introduced by the European Commission through the Lump Sum Grant approach; after extensive internal discussions and analysis decided to propose to the S2R GB, as part of the AWP 2018, the adoption of the Lump Sum Grant for the CFM part of the 2018 Call, as a pilot project. This meets R&I stakeholders expectations that public international bodies in charge of mission-oriented Programmes, such as the S2R JU, be willing to experiment with both bringing in new expertise (e.g. establishing novel forms of collaboration to pool and share expert knowledge) and changing routines and processes to build dynamic organisational capabilities (including performance management, procurement, grants, etc.). The S2R JU is at the forefront of such processes in a risk management approach.

The implementation of the pilot Lump Sum Grant it is set up in a confined Programme control framework, i.e. for the Projects to which the S2R JU Members are eligible. In fact:

a. although the Lump Sum Grant approach does not require the beneficiaries to report on detailed eligible costs and audit requirements, the Total Project Cost of the S2R JU Members is subject to audit and certification in accordance with Article 4.4 of the S2R Regulation. Hence, in this specific context, Lump Sum Grants halve the costs of financial audits without undermining reasonable assurance;

b. the S2R JU Members agreed to limit their request of co-funding to 44.44% compared to the H2020 rates of 100% (+25% flat rate for indirect costs) or 70% (+25%) depending on the nature of the Action, that is fully described (including FTEs). As a result, the co-funding to be received by the S2R JU Members does not exceed the 35.5% of the direct costs sustained by the latter to deliver the R&I activities of the S2R Programme (44.44 / 1.25 = 35.5). This means that the financial risk embedded in the Lump Sum Grant is extremely contained within the S2R JU: only one third of the costs needed to achieve the results might be exposed to eligibility/financial risks. This is not the case for any other programme under H2020;

c. there is an obligation for the S2R JU Members to limit their co-funding requests up to 44.44%, hence an obligation to deliver at least 55.56% of activities at their own costs. As a result, if the estimated Lump Sum Grant were to be overestimated compared to the Total Project Cost of one action, the concerned Members would be in the obligation to increase their activities up to the level of a balanced cumulative 44.44% co-funding and 55.56% IKOP (as a difference between Total Project Cost and co-funding received).

Consequently, the implementation of the Lump Sum Grant approach within the S2R JU Call for Members activities, although for key project values, remains in a confined environment where checks and balances are in place beyond the usual H2020 eligibility rules.

The R&I planned to be performed complements the activities already ongoing, with the objectives to reach higher TRLs (up to 7) or start work on specific domains (TRL 0 – 3). The following tables give a synopsis of the calls.

Activity	Type of call	Value of the actions (*)	Maximum S2R co-funding (*)	In-kind contribution (*)	publication date
Call for Proposals and/or Call for tenders	JU members eligible only	134.1	59.6	74.5	Q1 2018
Call for Proposals	Open, JU Members excluded	21.1	19.1	2.0	Q1 2018
Call for Tenders	Open	2.3	2.3	N/A	
Operational Experts	Open, including through REA	0.3	0.3		
Total		**157.8**	**81.3**	**76.5**	

(EUR million)

With the Calls 2018 R&I activities up and running, the R&I activities performed in the Programme will reach EUR 489.2 million (including Lighthouse Projects as part of the S2R initiative), of which EUR 399.3 million performed by the Other Members with a co-funding made available by the S2R JU up to a maximum of EUR 194.8 million.

While in accordance with the respective Membership Agreements the Other Members agreed to limit their request for co-funding to 44.44% of the Total Project Costs, the OC topics are co-funded at the rates established in the H2020 Rules of participation
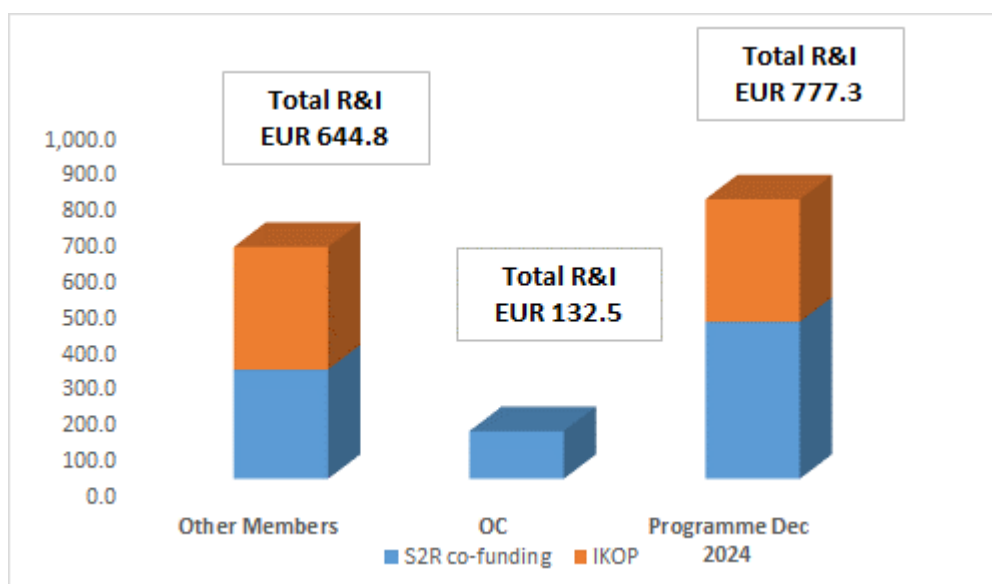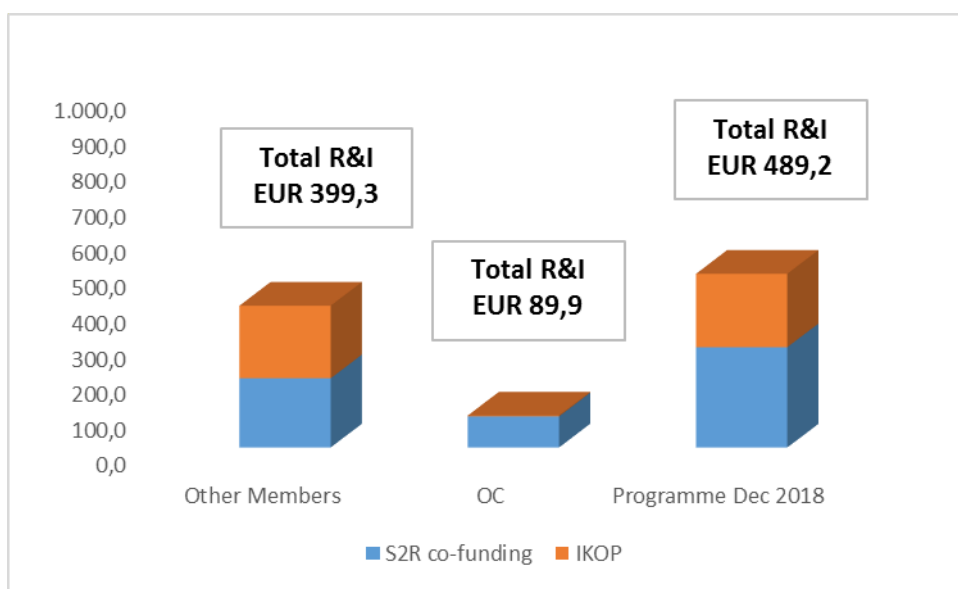
2. SUPPORT TO OPERATIONS

2.1. Communication activities

While in 2016, the communication activities were still in set up phase, 2017 was a year of full implementation. The overall objective of 2017 was to promote the S2R Programme as an integral part of the day-to-day railway world, publicize and disseminate the innovative results coming from the R&I activities, and secure stakeholders commitment. Through a number of communication actions, such as the adoption of the S2R Communication Strategy, Shift2Rail's communication activity reached its full speed. A closer cooperation between S2R, decision makers, stakeholders and projects enhanced the outreach and improved the communication impact of the S2R Programme. Furthermore, two communication agencies have been selected as a result of the tender procedure launched in the beginning of the year to support the communication activities of S2R.

2.1.1. Events

The S2R JU participated in a number of institutional, external and internal meetings and conferences organised in Brussels and in some of the EU Member States.

Institutional

In the context of the Estonian Presidency of the Council of the European Union, S2R JU participated in two major events: the Connecting Europe Conference (21-22/09) and Digital Transport Days (8-10/11). The S2R JU had a stand at both events and participated in different panel sessions focusing on the challenges the transport modes are facing in the process of automation and digitalisation. The conference was attended by key participants in the sector, from Member States, EU Presidency, Commission, S2R Members, Associations and stakeholders.

The Digital Transport Days marked in particular a significant moment for S2R JU, as it presented the newly adopted Multi-Annual Action Plan – Executive View (MAAP Part A) to EU Transport Commissioner, who reinforced her support for the S2R JU and its Programme, highlighting the importance of its Programme delivering cutting-edge R&I results and starting to exhibit them at the InnoTrans 2018.

Other Institutional events such as the SERA Convention (20/06), European Mobility week (16-22/09), European Innovation Summit (27-30/11) and Horizon 2020 Transport Info Day (12/12) saw also the S2R JU's active participation.

External events

Participation to the bi-annual International Railway Summit, which took place on 16th February and 15-17th November, enables delegates to network with peers from across the world and across the supply chain, to exchange ideas, build contacts and create strong business partnerships.

The UITP Global Public Transport Summit, Montreal 17/05, is a unique biennial event that covers all urban and regional transport modes. Combining a full programme of congress sessions with an extensive exhibition of the latest solutions in public transport. Ongoing work in S2R JU to meet expectations in terms of more energy efficient railways in Europe were highlighted focusing both on research and innovation activities tackling different parts of the railway system and on the market uptake of the new innovative solutions.

TRAKO, Poland 26-29/09, is the most prestigious rail industry meeting in Poland and one of the largest in Central and Eastern Europe. In view of the future deployment of S2R innovative solutions, the S2R JU is working towards establishing relations with more Eastern European countries.

On 27 November 2017, the EU officially launched the Platform for Change aimed at increasing female employment and equal opportunities in the transport sector. Part of the event was the signing of the Declaration to make the endeavours in favour of gender equality more widely known. With 50% female staff, the S2R JU was proud to be present and support the initiative.

POLITICO's Connected Transport Summit, Brussels 04/12, mapped out the disruptions shaping the future of transport in Europe while setting out how the technologies of tomorrow fit in with the infrastructure of today. S2R JU was among the only representatives of the railway transport mode, highlighting with that the primary role of railways in a truly multimodal and connected future mobility system.

As a result of S2R JU starting to showcase its cutting edge research & innovation solutions the number of external event participations has multiplied compared to the year before. With various Conferences, such as International Rail forum (22-24/03), Stephenson Conference (25-27/04), International Physical Internet Conference (4-6/07), CyberSecurity4Rail (04/10) and Summits such as Railway Pro Investment Summit (3-4/10) and Railway Gazette's European Rail Summit (7/11), the S2R JU has increased its visibility.

S2R JU events

Rail Forum Europe Breakfast - This breakfast-debate, which took place in Brussels on 3 May gathered 60 participants, including MEPs, representatives of the European Commission and Member States and rail stakeholders. The key message put forward at the event was the need for continuity and adaptation to the ongoing challenges in order to make rail research a win-win for European citizens and the rail sector and to pave way for the successor of S2R Programme, the S2R 2030.

Fuel Cells and Hydrogen Joint Undertaking (FCH JU), the S2R JU and Hydrogen Fuel Cells and Electro-Mobility in European Regions (HyER) have come together to organise a seminar on hydrogen trains on 15 May 2017. The seminar analysed the opportunities that hydrogen fuel cells can bring to the rail industry and looked at passenger transport, freight and shunting or switching. Regulation and safety issue were also an active part of the programme.

On the 24 – 26 of October S2R JU with six other Joint Undertakings invited Members of the European Parliament, European Commission, Scientific Committee, Industry Representatives and other Stakeholders to attend the 'Innovation in Action' exhibition in the Strasbourg European Parliament. The Joint Undertakings managed to convey the messages:
1. Powerful platforms providing answers to the needs that have no existing solutions,
2. Attracting support and leveraging current and future industry funding and
3. Delivering results that translate into concrete benefits for European citizens

ROLL2RAIL (LP) Final Conference –ROLL2RAIL (LP) became the first S2R Lighthouse Project to finish; the added value of the project results on the work of S2R JU was highlighter.

The S2R JU held its second Info Day for Open call in Brussels on 12 December 2017. The information day provided an overview of the S2R Research & Innovation Programme, focusing in particular on the upcoming funding opportunities under the umbrella of the Horizon 2020 Programme. More than 200

participants attended the full day discussion on the Call for Proposals 2018 and how to apply for grants, while close to 50 people have followed the first part of the day online.

Regional Information days on S2R JU open Call for Proposals
- 24/01 in Athens
- 09/02 in Lisbon
- 25-27/07 in Israel
- 20/11 in Paris
- 04/12 in Vienna

2.1.2. On-line communication

Website

In 2017 the S2R web site was slightly restructured to interface better with S2R collaboration tool in particular for the description of projects. Further, the News, Events and Highlights sections were heavily used and an increased use of good quality images contributed to render the site more attractive. The first two issues of S2R e-news were also launched. All this resulted in an increase of 22% of the number of visitors compared to 2016 and a 54% growth on the number of pages viewed.

As per the previous year, the events calendar was updated constantly with all S2R JU events and meetings. Documents approved by the S2R GB have been made accessible and Press Releases or articles covering S2R activities were regularly posted.

Social media

The S2R JU has dedicated time and resources not only to maintain its social media accounts – Twitter, LinkedIn & Facebook – but to also increase the number of followers and the amount of content posted, in order to attract new audiences and generate new interest.
The S2R JU's social media accounts remain a primary instrument to communicate on the progress of its work, promote its activities and connect among many to decision makers, stakeholders, individuals, scientific community, etc.

Press

2017 has been a great year for S2R JU in terms of press coverage. S2R JU was featured in articles in a range of magazines, industry press and online media.

Much of the press interest stemmed from the Call for proposal 2017 results, high level events attended, publication of the Call for proposals 2018.

Furthermore In light of S2R JU beginning to deliver the innovative solutions necessary to meet the needs of railway operators and network managers, multiple publications, videos and reports have been developed and published in 2017 by the Other Members and OC as part of the communication and dissemination of the Projects' results.

In order to maintain momentum and keep focus on its activities, in October 2017 the first newsletter of S2R JU has been launched and in total 2 newsletter issues have been sent out by the end of the year. In the bimonthly newsletter the S2R JU is writing about the progresses, achievements and success stories of Research & Innovation Programme as well as giving an insight into Innovation

Capabilities delivering the railway system(s) of the future. The second issue of the newsletter was largely dedicated to women in rail, following the launch of the women in transport platform.

2.2. Legal and financial framework

The S2R JU legal framework refers predominantly to:

- Council Regulation (EU) N°642/2014 of 16 June 2014 establishing the Shift2Rail Joint Undertaking (OJ L 177, 17.6.2014, p. 9),
- The Financial Rules of the S2R JU, as adopted by the S2R GB on 30 July 2014 and the revised Financial Rules of the S2R JU, as adopted by the S2R JU on 11 December 2015.
- The S2R GB Decisions adopted since its establishment which framed the functioning of the S2R JU within the boundaries of the S2R Regulation and its Financial Rules.

In addition:

- Regulation (EU) No 1291/2013 of the European Parliament and of the Council of 11 December 2013 establishing Horizon 2020 — the Framework Programme for R&I for the period 2014-2020 and repealing Decision No 1982/2006/EC (OJ L 347, 20.12.2013, p. 104), as well as 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 (OJ L 347, 20.12.2013, p. 81) is applicable to the grants awarded by S2R;
- The Staff Regulations of officials and the conditions of employment of other servants of the European Union are applicable to the staff of the S2R JU.

Additional reference documents may be found on the S2R JU's dedicated webpage: http://shift2rail.org/about-shift2rail/reference-documents/.

2.3. Budgetary and financial management

At the year-end 2017, the JU had implemented 100% of its commitment appropriations made available in its active budget. The payment appropriations were executed up to 82.5% of the available funds, due to the fact that the submission of request of co-funding from ongoing Projects was lower than estimated.

In S2R GB Decision 25/2016 of 9 November 2016, the S2R GB adopted the AWP and initial budget for 2017. S2R GB Decision, 5/2017 of 27 October 2017, amended the initially adopted budget later in the year.

The Amending budget corresponded to the specific needs of the JU, including transfers within the initially adopted budget, recognising the unused Payment and Commitment Appropriations on administrative and operational expenditure in relation to the previous budgetary years and the move of expert expenses on Call evaluations from the administrative to operational line.

The budget amendment also cancelled the payment appropriation assigned for the S2R Lighthouse projects. Since the initial planning of the budget, it had been decided that these projects would remain under the administration of the European Commission. For this reason, the relative appropriations remained in the European Commission and not transferred to the JU.

In addition to its active budget and in accordance with the S2R Financial Rules Art.6(5), the S2R JU has established in its Budget Title 4: Un-used Appropriations not required in the year. This Title is of technical nature and, in accordance with the S2R Financial Rules, recognise the appropriations available for applying n+3 rule on the following budgetary years.

In addition to the transfers made towards Title 4 as part of the budget amendment, the Executive Director has executed its rights in Accordance with Article 10 of the S2R Financial Rules by transferring appropriations from Title 2 to Title 4. This action has been implemented as response to the multiannual budgetary planning of the JU. The JU has ability to reactivate credits from Title 4 in the following budgetary year. This reactivation will be implemented as part of budget amendment in 2018.

Title	Commitment appropriations (including reactivations)				Assigned revenue appropriations	Total appropriations available	Commitments made	EUR '000 %
	Initial budget adopted	Amending budget	Transfers	Final adopted budget				
	(1)	(2)	(3)	(4)=(1)+(2)+(3)	(5)	(6)=(4)+(5)	(7)	(8)=(7)/(6)
1	2 082	0	0	2 082	0	2 082	2 082	100,0 %
2	1 661	(116)	(102)	1 443	23	1 466	1 443	98,5 %
3	61 508	(449)	0	61 059	0	61 059	61 056	100,0 %
Total	65 251	(565)	(102)	64 584	23	64 607	64 581	100,0 %
4	2 326	1 541	102	3 969	0	3 969	0	0,0 %
GRAND TOTAL	67 577	976	0	68 553	23	68 575	64 581	94,2 %

Commitments made on title 3 (61056) is including commitments made by REA executive agency in the framework of Expert contracts for an amount of 153 KEURO.

Title	Payment appropriations (including reactivations)				Assigned revenue appropriations	Total appropriations available	Payments made	EUR '000 %
	Initial budget adopted	Amending budget	Transfers	Final adopted budget				
	(1)	(2)	(3)	(4)=(1)+(2)+(3)	(5)	(6)=(4)+(5)	(7)	(8)=(7)/(6)
1	2 082	227	0	2 309	0	2 309	1 880	81,5 %
2	1 661	484	0	2 145	23	2 168	1 196	55,2 %
3	52 040	(14 507)	0	37 533	0	37 533	31 587	84,2 %
Total	55 783	(13 796)	0	41 986	23	42 009	34 664	82,5 %
4	1 177	931	0	2 108	0	2 108	0	0,0 %
GRAND TOTAL	56 959	(12 865)	0	44 095	23	44 117	34 664	78,6 %

Payments made on title 3 (31587) is including payments made by REA executive agency in the framework of Expert contracts for an amount of 153 KEURO.

Administrative costs (Title 1 Staff Expenditure and Infrastructure and Title 2 Operating Expenditure)

Title 1 and Title 2 of the S2R Budget was executed up to 99.4% in commitment appropriations, demonstrating a reliable budgetary planning. The un-used appropriations represent kEUR 23 of C4 credits realised within the year but not falling as part of the budget as adopted by the S2R Governing Board.

Title 1 - Staff Expenditure was mainly used for the salaries of the JU staff. During the year, the JU made also use of external support, to fill the gaps during the recruitment process on staff turnover and to cope with the important workload on JU activities.

The execution rate of the Payment Appropriations was 68.7%; this execution rate is lower than Commitment Appropriations due to payments becoming due only in 2018 and afterwards. However, this rate has increased from the respective reported rate in 2016, demonstrating the impact of multiannual contracts under administrative line.

During the year, S2R collected the contributions against its Administrative Budget from the Union and its Other Members in full. As a part of the Budget Amendment of October 2017, GB Decision 5/2017, the JU reduced its total budgeted amount on Commitment Appropriations under Title 2. This reduction was implemented as a response to the decision on moving the evaluation expert costs under the operational line and responding to the specific needs within each line of the Title to ensure the adequate phase in of activities. The Payment Appropriation were increased in overall Administrative Budget as a response to the amounts due in relation to the previous budgetary years.

In addition to the budget amendment, the ED has executed its rights in Accordance with Article 10 of the S2R Financial Rules and transferred Appropriation from Title 2 to Title 4 in the course of the year. This action has been implemented as response to the multiannual budgetary planning of the JU and its ability to reactivate credits from Title 4 in the following budgetary year. The appropriations will be reactivated and implemented in budget 2018.

Title 3 Operational Expenditure

Title 3 of the S2R Budget constitutes the JU's Operational Budget. The fast majority of the JU's budget falls under this category representing 94.5% of the active budget and 89.0% of the overall budget (including Title 4). The budget category covers the JU's Call for proposals, Operational procurement and expert fees occurred as part of the evaluation.

The execution rate of the Operational budget in both Commitment and Payment Appropriations was respectively 100% and 84.2%. Majority of the Payment Appropriations were used for the pre-financing of the Grants resulting from the 2017 Call for Proposals.

As a part of the Budget Amendment of October 2017, GB Decision 5/2017, the JU reduced its budgeted amount on Commitment Appropriations under operational expenditure by 1%. This amount was realised after the revaluation of all operational expenditure and moved to the Title 4. This action has been implemented as response to the multiannual budgetary planning of the JU and its ability to reactivate credits from Title 4 in the following budgetary year. The appropriations will be reactivated and implemented in budget 2018.

Title 4 Unused appropriations not required in current Year

The amount included under Title 4 – Unused appropriations not required in Current year has been established to support a transparent implementation of S2R JU Financial Rules Art.6(5), the so called n+3 rule. In accordance with the Financial Rules and the general practise of the JU, these appropriations will be reactivated in the budget of the following year, n+1, and used first.

As a part of the Amendment No 2 to the Budget of October 2017, GB Decision 5/2017, the JU has included to its budget the reactivated credits from T1, T2 and T3 resulting from the previous budget years. In addition, it has moved credits within the initial budget to Title 4. After the adoption of the amendment and as described in earlier chapters, the Executive director has executed its rights in

Accordance with Article 10 of the S2R Financial Rules and transferred Appropriation from Title 2 to Title 4.

From the total of kEUR 3 969 recorder under Title 4, kEUR 3 867 has been re-activated in the initial budget 2018 under the respective Annual Work Plan. The remaining amount will be re-activated as part of the Budget Amendment for the year together with any un-used appropriations on T1, T2 and T3 on budget 2017.

2.4. Procurement and contracts

In order to reach its objectives and adequately support its operations and infrastructures, the S2R JU continued in 2017 to allocate funds to procure the necessary services and supplies. In the interest of sound financial management and to the possible extent, the S2R JU made use of SLAs (Service Level Agreements) with relevant Commission services (ICT, training, payroll, mission, experts reimbursements, interim staff, etc.) and participated in inter-institutional framework contracts (travel agency services, IT services or office supplies). In addition, for services related to its premises, the S2R JU participated in inter-JUs framework contracts (IT services and interim staff services). In 2017 the S2R JU used its own frame-work contract for communication and events services

When for specific services or supplies a SLAs or a framework contract were not available, the S2R JU resorted to low-value contracts.

In order to establish the maximum values of procurement contracts, where necessary, the JU makes use of the collective experience of its staff involved in it, its Members and experts as necessary, driven by the principle of sound financial management. Although this was not formally documented in formal acts, audit trails are available also in the exchanges between the staff and the procurement sector to finalize the call for tenders before approval by the Executive Director.

2.5. IT and logistics

S2R has implemented common ICT tools designed and offered by the European Commission (EC) on the financial management and H2020 call management. These tools are updated and maintained on regular basis by the EC; they require continuous input from the side of the JU, on the one hand, in terms of future developments to meet the expectations of the partnership and, on the other hand, to correct the multiple and repetitive mistakes. The follow up of these processes absorb multiple resources of the JU.

In addition, S2R is making use of the training services offered by the EC on these applications to assure their correct usage and implementation.

For the call for proposals in the AWP 2018 the 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.

S2R JU is participating to the joint strategic ICT plan of the Joint Undertakings located in the White Atrium building. During 2017, the physical infrastructure was migrated to a private cloud computing infrastructure and it is expected that during 2018 the rationalization process will continue to maximize the limited resources available.

In 2017 analyses were conducted to further advance the adoption of the EC's ICT systems for HR (Sysper) and daily document management (ARES/HAN). The objective behind is to leverage the EC's

proven working technology solutions already in place, but also to streamline and further harmonize the processes, procedures of record management, document archiving and electronic document cataloguing, secure storage and document access.

2.6.   Human Resources

In 2017, in accordance with the staff establishment plan, S2R JU recruited seven staff members: the Legal Officer, the Administrative and Finance Assistant, the Operation and Grant Support Officer, four Programme Managers (one Programme Manager is currently on the post "*Internal Control and Quality Officer*").
Three Programme Managers recruited in 2014 and 2016 and the Programme Assistant (Secretary) left the team in the second part of the year and are being progressively replaced.

On top of the recruitment activities and routine daily HR management, particular attention was given to the swift and concrete implementation of HR-related decisions adopted by the S2R GB (Implementing rules). Furthermore it was carried out the first reclassification exercise of the JU, and improved the in-boarding program for newcomers. Service level Agreements have been established, and where necessary reviewed, with the relevant Commission services aiming to ensure HR administration. These agreements are important insofar they provide staff members with the opportunity to ensure their development, although in high workload environment, in areas in relation with the core business of the JU.

For the first year, the JU welcomed Bluebook Trainees in accordance with the SLA signed with DG EAC.
The call for expression of interest for Seconded National Experts (2) was launched at the end of the year with possible recruitment in 2018.

In 2017, the S2R JU team consisted of 20 staff members out of 23 foreseen in the establishment plan (see ANNEX B Establishment plan)

3.   GOVERNANCE

3.1.   Governing Board

In accordance with the S2R Regulation, the S2R GB continued its work steering the JU through decisions to be implemented and executed by the Executive Director. Four meetings of the Board were convened in 2017 dealing with both operational and administrative aspects. Important decisions were taken, such as the approval of the list of actions proposed by the Executive Director selected for funding under the 2017 Call, the amendment of the Multi Annual Action Plan (part A) and the adoption of the 2018 Annual Work Plan including, for the first time, the adoption of the lump sum funding pilot scheme, which is expected to contribute significantly towards the administrative simplification of the R&I activities.

In addition, the S2R GB amended the AWP 2017 in order to include the invitation to the Associated Members of the S2R JU to submit an answer in view of the realignment of their activities and additional commitment to the S2R Programme. In this context the JU evaluated the answers submitted by the Associated Members and initiated the negotiations for the final realignment of resources. The final decision on this topic will be taken by the S2R GB in early 2018.

Moreover, a number of decisions were adopted concerning administrative issues and issues related to the personnel (adoption by analogy of rules of employment of staff of the European Union).

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 S2R GB. The Executive Director is the legal representative of the S2R JU. The Executive Director is accountable to the S2R GB. He is supported by the JU staff organized in a Programme Office.

The S2R JU Executive Director was appointed on 16 February 2016. He took his duties on 16 May 2016.

The Executive Director is supported by the Head of R&I a.i. and the Head of Finance and Administration. The Programme Office under its responsibility has produced in early 2017 the Governance and Process Handbook which describes in details the processes and procedures to monitor the performance of the Projects that will be implementing the Programme through an integrated Programme Management approach.

3.3. States Representatives Group

To date, 32 countries have nominated representatives to this group. During 2017, the States Representatives Group (SRG) held its sixth and seventh meetings on 21 March and on 20 September respectively. One of the main tasks in both meetings was the consultation with the Member States and the Associated Countries on the JU's Annual Work Plan (AWP) 2018 as well as on the review of the Multi Annual Action Plan.

In the sixth meeting, which took place in Prague, the SRG discussed the Research & Innovation activities beyond 2020, in the presence of the Minister of Transport of Malta (at the time holding the presidency of the Transport Council) and the Deputy Director General of DG MOVE. In the seventh meeting, the discussions focused, inter alia, on the concept of the establishment of MoUs between the JU and regions, in order to combine national R&I activities with activities of the JU, resulting (e.g.) in additional resources for funding of demonstrators.

In both meetings, the participants were informed in detail about the ongoing and planned activities of the JU.

3.4. Scientific Committee

The Scientific Committee (SC) is an advisory body to the S2R JU focusing on the long-term research and identifying scientific and technological achievement and development priorities.

The S2R JU Scientific Committee held its sixth meeting on 5 April 2017. The JU presented the revision of the S2R MAAP Executive View (Part A), the review of the lighthouse projects and of the first members' projects as well as relevant dissemination and communication activities such as the abstract submission for the Transport Research Arena (TRA). The members examined also the draft

2018 Annual Work Plan (AWP), and provided specific comments on the different topics in order to contribute to the document finalisation.

The seventh meeting of the S2R JU Scientific Committee was held on 19 June 2017. The Executive Director provided an update on the state of play of the S2R JU related to the ongoing programme activities focusing on the results of the 2017 S2R call, the revision of the MAAP as well as feedback from the S2R GB meeting. The SC provided the opinion on the final draft Annual Work Plan 2018. There was an exchange of views on the possible collaboration of the SC with the European Technology Platform on railway research ERRAC.

The eighth meeting took place on 24 November 2017. Besides the update on current activities and planning for 2018, the SC focused on the brainstorming for the future of S2R and preparation of a roadmap for the AWP 2019 and the possibility to draft call including topics to explore blue-sky research. On the short-term, it focused on the launch of the 2018 call for proposals and for tender, on the ongoing Grants Agreement Preparation and the participation to TRA and InnoTrans 2018 events.

In addition, in order to fill one position becoming vacant in 2017, the S2R JU launched a call for expression of interest for the selection of a new member of the S2R SC holding expertise in the field of telecommunication, information technology, artificial intelligence and/or digital science. Applications received by the call closure were 16 and the S2R GB has appointed the new member of the SC in December 2017.

In the context of the continuous process for the assessment of Conflict of Interest, the S2R JU took note of the declarations provided by the members of the SC in view of addressing possible risks. This will be further discussed at the first meeting of the SC planned in April 2018.

3.5.   Innovation Programme's Steering Committees

In 2016 all IP's Steering Committees were formally established and each of them adopted its Rules of Procedures, in line with the indications of the S2R GB.

The Steering Committees convened regular meetings (four meetings in total in 2017) and their role was to ensure the necessary coordination of activities within each IP and to provide input in assisting the JU in the planning of its future activities (i.e. input for the AWP 2018 and AWP 2019, the global planning, the MAAP review, etc.). As from the signature of the first OC grants, the coordinators of the OC projects were invited to participate to the Steering Committee meetings in order to present their plans in a way to ensure coordination of actions and to maximise synergies among projects.

During 2017, the S2R JU together with the IP Coordinators work towards the evolution of the IP meetings more on technological and operational content than administration. This will be further enhanced in 2018, focusing on TDs results and adding IPs' joint meetings on specific thematic areas (automation, digitalization, telecoms, cyber-security, integrated traffic management, etc).

3.6.   European Union Agency for Railways (ERA)

Article 12 of the S2R Statutes clarifies the areas of cooperation between the S2R JU and ERA. In order to ensure that strong cooperation is established with ERA, the rules of procedures of all relevant groups established by the S2R JU foresee the participation of representatives from the ERA (either as

observers or direct members of these groups); this ensures that the Agency is duly prepared to take into account the results of the Programme in its activities.

As a result, staff members of ERA have been participating in meetings of the S2R GB (cf. 3.1) and the IP Steering Committees, but also in the groups which were tasked with the drafting of the Multi-Annual Action Plan and contributing to the S2R JU Annual Work Plans.
In 2017 the S2R JU in agreement with ERA built in its Governance and Process Handbook[19] the process for an effective working cooperation. In particular the document clarifies the way ERA can access the R&I activities performed within the S2R Programme in the areas of their competence, interoperability and safety.

In addition, regular coordination meetings have been organised between the two Executive Directors, operational staff and communication staff. The overall objective is to ensure that the R&I innovative solutions that will be delivered by the S2R Programme will be considered in the pipeline of ERA activities in order to avoid any step back in the future market uptake.

The role of ERA in the context of 4th Railway Package, once duly implemented, will be another asset to facilitate the deployment of the S2R Innovative Solutions.

In addition, with the objective to avoid overlapping activities, the S2R JU assess the requests for R&I coming from ERA and ensure their implementation to maximize the use of public funding. Building upon parallel structures would constitute a waste of resources.

The S2R JU also supported the European Commission in its ERTMS Deployment Action Plan, participating to the ERMS Policy Board meetings and advertising the ERTMS Deployment Action Plan Consultation on its website.

4. INTERNAL CONTROL FRAMEWORK

4.1. Financial Procedures

The S2R JU Financial Rules were adopted by the S2R GB on 30/07/2014 and amended on 11/12/2015. The Financial Rules do not depart from the model Financial Regulation for public-private partnership bodies referred to in Article 209 of the Regulation (EU, Euratom) No 966/2012 of the European Parliament and of the Council of 25 October 2012. Since its budgetary autonomy, the S2R JU has been using ABAC (accounting system of the European Commission) for its financial management.

The S2R JU Manual of Financial Procedures has been prepared in line with Article 17(3) of the Financial Rules of the S2R JU and incorporated. The main purpose of the document is to identify actors, describe the financial circuits and detail procedures regarding the implementation of the S2R JU Budget. The financial circuits take into account the structure of S2R JU and the risks associated with the management environment.

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[19] https://shift2rail.org/wp-content/uploads/2017/12/S2RJU-Governance-and-Process-Handbook_20171010_v11_Cleanv-nd.v2.pdf

The Financial Rules of the S2R stress the need to differentiate between the initiation of a financial transaction and the verification of the same transaction in order to guarantee the principle of segregation of duties.

The S2R JU budget in respect of this document has been divided mainly into two types of expenditure;
- Administrative Expenditure covering both; Titles 1 and 2 of S2R Budget, and
- Operational Expenditure covering Title 3 of the Budget.

The new Title 4 is dedicated to account for un-used appropriations.

Due to their nature and the difference in ICT tools implemented at the S2R JU to manage them, the financial circuits between these two expenditure types are different.

The Manual of Financial Procedures describes in detail financial circuits the S2R JU implements per type of transactions and the roles and responsibilities of each actor involved. To a less extent, it also describes the basic principles on main procedures (grants & procurements). In 2017, this document has been reviewed to streamline and improve the internal financial processes.

It should be noted that the specific S2R JU financial procedures are complemented by *vademecum* established for the overall H2020 research family as well as by S2R JU Programme Handbook.

The S2R GB formally appointed the Accounting Officer of the Commission as the Accounting Officer of the S2R JU on 18/03/2016.

4.2. Ex-ante Controls on operational Expenditure

The S2R JU adopts the standard financial circuits in ABAC Workflow for the commitments and payments. The circuit has a three-step authorisation performed by the following financial actors:

- Initiating Agent (OIA and FIA)
- Verifying Agent (OVA and FVA) and
- Authorising Officer (AO).

Staff members designated by the Authorising Officer to verify financial operations are chosen on the grounds of their knowledge, skills and appropriate professional experience.

The S2R financial circuits comply with the requirements of the four eyes principle, segregation of duties and the independence of the verifier. In addition, in view of the limited staff, they also provide the flexibility necessary to ensure the continuity of operations.

For the operational expenditure of the JU, S2R recognises two different types of transactions: ones solely performed in the ABAC Workflow and ones with the initiation and verification functions outside the ABAC environment in a tool called SYGMA. This tool is also linked to ABAC which allows real time controls over the budget and its implementation.

The nature of the transaction defines the system where the initiation and verification is performed:
- ABAC for all procurement related transactions and
- SYGMA for any transactions related to grant management

In all transactions, whether initiated in SYGMA or ABAC, the Authorising Officer (AO) will give his/her authorisation in ABAC only.

A key element of the ex-ante controls is the "*GuidanceH2020 ex-ante controls on interim & final payments*" adopted by the CSC Steering Board on 15 Dec 2016 and applicable as such to the S2R JU. The main consequence of this simplified ex-ante control approach is that the limited details asked to beneficiaries to be provided in each periodic report do not allow the S2R JU to check most of the conditions for the eligibility of costs. Ex-ante controls in H2020 are therefore trust-based, focusing on whether:

- the work has been done (as described in the periodic reports)
- the reported effort and use of resources is reasonable and in accordance with the plan
- sufficient explanation and justification are provided for any substantial deviations (see Section 2.5).

In practice, the assessment involves comparing the Description of the Action (DoA) and the budget earmarked with the work actually carried out, as explained in the periodic report, and the costs being claimed in connection with it.

Certain elements (such as risk factors or deviations) are less in evidence when checking interim periodic reports than when assessing final reports. Moreover, since CFS are required only as part of the final reports, ex-ante controls in final periods will be more in-depth. Moreover, officers may take a more flexible approach to ex-ante controls in interim periods by asking beneficiaries for additional clarification in the ensuing reporting period. However, by the time the final payment is made, all outstanding issues should have been dealt with.

4.3. Ex-post Control of Operational Expenditure and Error Rates Identified

Ex-post controls are defined as the controls executed to verify the financial and operational aspects of finalised budgetary transactions in accordance with Article 19 of the S2R JU Financial Rules.

The controls are the last stage of the JU's control strategy in the project life cycle. This stage includes the ex-post audits as well as the recovery/correction of any amounts found to have been paid in excess of the sum due.

Ex-post Control of Operational Expenditure at S2R fall under the H2020 Audit Strategy. The implementation of the H2020 Audit Strategy will be the responsibility of the Common Audit Service (CAS).The role of the CAS is defined in the Commission Communication of 18 September 2013 establishing the Common Support Centre (CSC)[20]. The CAS has been designated as the single entity for implementing the H2020 audit campaign on behalf of the CSC stakeholders such as S2R.

The main objective of the H2020 Audit Strategy is to provide the Executive Director with the necessary elements of assurance in a timely manner on the H2020 budget for which they are responsible by contributing to:

- assessing the legality and regularity of H2020 project payments;
- providing an indication of the effectiveness of the related ex-ante controls;

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[20] Communication on the delegation of the management of the 2014-2020 programmes to Executive Agencies SEC(2013)493 of 18 September 2013, section 5.1.2

- providing the basis for corrective and recovery mechanisms, if necessary;
- attaining residual error rates at an acceptable level at the closure of H2020, once the financial impact of all audits, correction and recovery measures has been taken into account[21].

The actions identified to realise these objectives include :
- the gradual achievement, in a cost effective-way, of quantitative multi-annual targets in terms of audited participations;
- the closure and communication of audit findings and extension of audit findings to those responsible for their implementation providing the basis for corrective and recovery activities, if necessary.

Ex-post control initiated in 2017: S2R Specific sample

In 2017, the S2R JU validated its first cost claims resulting from the execution of grant agreements (interim payments). These claims constituted the population to be sampled in view of conducting to the ex-post audit within the year.

The population consists of 155 participations (claims), from 75 beneficiaries (Members, Associated Members, affiliated entities) executing 13 grant agreements with total validated H2020 funding of EUR 3.3 million.

	Number	%	Value	%
Participations validated by S2R in 2017	155	100	3,273,271	100
Participations sampled towards target 2018	15	10	1,303,975	40

The representative sample of the JU was identified at 15 participations representing EUR 1.3 million in terms of S2R co-funding validated. The respective audits were launched with a target closure at 31.12.2018. Nevertheless, it is expected that the preliminary audit reports will be available well in advance compared to the 31 Dec deadline.

Ex-post controls of the H2020 programme globally in 2017

Given the stage of the programme lifecycle, a limited number of cost claims totalling EUR 4.1 billion of requested funding had been received by the services by the end of 2017. The first Horizon 2020 audits were launched in the middle of 2016 and further audits were launched in 2017. The first Common Representative Sample (CRS), a Common Risk Sample and the additional samples (such as the S2R JU specific sample here above) have been selected. In total, by December 2017, 625 participations had been selected for ex-post control audits, covering all the services signing grants in Horizon 2020.

In total, the audit of 392 participations has been finalised (385 on 2017 selection of 625 participations and 7 on the 2018 selection). This includes 110 out 142 selected in the first CRS. The error rate on 31/12/2017 is:

Overall detected error rate based on 392 participations: 1,54 %.

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[21] Legislative Financial Statement as part of the 2011 Commission proposal for the Regulation on H2020 (COM/2011/809) of 30 November 2011, pages 98-102

Representative Error Rate for the Framework Programme: The detected error rate based on 110 out of 142 participations selected in the first CRS is 1,6%. However, if we take into account the draft audit reports then the expected representative error rate for the full sample will be around 2,82%.

Residual Error Rate for the research family: 1,44 %, expected to rise to around 2.24% when taking into account the draft audit reports (this last figure will be updated as we go along).

It is expected that these figures will evolve by the time of the submission of the present AAR 2017 to the European parliament and Council.

4.4.   Audit of the European Court of Auditors

The European Court of Auditors (ECA) with its mission of March 2017 completed its work which resulted in S2R JU Annual Audit Report for the year 2016, in accordance with the ECA mandate as defined in the TFEU.

The European Court of Auditors released the following opinions:

Opinion on the reliability of the accounts

"The accounts of the Joint Undertaking for the year ended 31 December 2016 present fairly, in all material respects, the financial position of the Joint Undertaking at 31 December 2016, the results of its operations, its cash flows, and the changes in net assets for the year then ended, in accordance with its Financial Regulation and with accounting rules adopted by the Commission's accounting officer. These are based on internationally-accepted accounting standards for the public sector."

Opinion on the legality and regularity of revenue underlying the accounts

"Revenue underlying the accounts for the year ended 31 December 2016 is legal and regular in all material respects".

Opinion on the legality and regularity of payments underlying the accounts

"Payments underlying the accounts for the year ended 31 December 2016 are legal and regular in all material respects."
Furthermore the S2R JU gave detailed answers to ECA reported findings; the report was adopted by the ECA at its meeting of 19 September 2017.

During the course of 2017 and in anticipation to the adoption of the final report, the S2R JU took the necessary actions to remedy to the main comments of ECA:

- The S2R JU established its own anti-fraud strategy and action plan.
- The S2R JU confirmed during the project interim payment control gate that two project coordinators have been demonstrating positive operational achievements and acceptable financial viability.

At the end of 2017, ECA started its work for the audit of the Annual Accounts 2017.

4.5. Internal Audit

The Internal Audit Service (IAS) of the European Commission performs the role of Internal Auditor of the S2R JU and, in this respect, it reports to the S2R GB and the Executive Director indirectly.

The first audit mission consisted in establishing a risk profile of the S2R JU with the objective to establish a triennial audit plan. The IAS Strategic Internal Audit Plan 2017-2019 has been presented to the S2R GB at its meeting of 7 June 2017.

This plan is mainly focussing on the review of the implementation of the ICS, of the H2020 grant process and of the JU performance management. The strategic internal audit plan will be subject to an annual review.

4.6. Risk management and conflict of interest

The S2R JU implements a risk policy to manage risks and opportunities related to the execution of the S2R Programme. The S2R JU follows the principles of the recognised international standards and aligns to the requirements of the European Commission as indicated in the Communication SEC (2005) "*Towards an effective and coherent risk management in the Commission services*".

Risk is defined as "*any event that could occur and adversely impact the achievement of the S2R Joint Undertaking strategic and operational objectives. Lost opportunities are also considered as a risk*".

The Risk Management system aims at enabling informed decision making with the objective of optimising the ratio between the level of acceptable risk by the S2R JU and the use of the relevant resources by anticipating and proactively identify, analyse, treat, control and monitor risks and opportunities.

With regard to programme specific risk management, the S2R Cooperation Tool as well as the relevant grant agreements related to the different Projects provide for the framework for management of risks and opportunities, with the possibility to scale them up at the proper level till the Executive Director and S2R GB.

For the purpose of implementing the requirements of Article 23 of its constituent act pertaining to the prevention of conflicts of interest, the S2R JU has adopted rules governing conflicts of interest in respect of its members, bodies, staff and seconded staff, as well as its S2R GB members. The responsibility on conflict of interest is within the competencies of the Executive Director.

4.7. Anti-Fraud Implementation and Indicators

The S2R JU during 2017 has put in place a tailor-made anti-fraud strategy complementing the H2020 strategy, including an assessment of its risks and opportunities.

In accordance with the S2R Anti-Fraud Strategy 2017-2020, 5 indicators are used to report on the results of fraud prevention and detection activities. At the end of 2017, the following can be reported:

	Indicator	Result

1	Number and value of contracts subject to close monitoring or additional controls due to an assessment of a high risk of fraud.	0
2	Number (and trend in number) of files sent to OLAF for investigation.	0
3	Time elapsed between receipt by staff or management of first information on alleged internal fraud and transmission to OLAF.	NA
4	Time elapsed between OLAF requests for information and date when information is provided to OLAF.	NA
5	Time elapsed between receipt of an OLAF report and the decision on recovery or disciplinary sanctions by the S2R JU	NA

4.8.   Compliance and effectiveness of Internal Control

The Internal Control Standards (ICS) is based on the Commission's ICS and adapted to the S2R JU's context and specificities; compliance with the standards are continuously monitored. An action plan was established at the end of 2016 and it is progressively implemented to ensure the sound financial management of the S2R Programme.

The following internal assessment of the S2R JU's ICS has been performed in order to evaluate the compliance and effectiveness of the Internal Control.

Shift2Rail JU Internal Control assessment 2018 - AAR 2017			
Scale	1:Not implemented - 2: partially implemented - 3: implemented - 4: largely implemented - 5:fully implemented		
Internal Control Standard	Definition	Assessment 2018 - AAR 2017	Status
ICS1	Mission	S2R JU's Mission and Objectives are published on the website and described in main official documents. Communication to staff is a key concern to ensure a values-centered work and appropriate service oriented to external stakeholders. However, the JU's Mission and Objectives text must still be harmonised in the different media to avoid possible ambiguities.	4
ICS2	Ethical and organisational values	Main Decisions on Conflict of Interests (S2R Staff Members and Bodies) are adopted by the Governing Board. In 2018 the JU has to formalise the rules laying down guidelines on whistleblowing in addition to the organisation of awarness session on anti-fraud (1 session already organised in 2017) and ethic.	3
ICS3	Staff allocation and flexibity	Flexibility and right balance between professional and personal life has been an important concern for the organisation. The staff turnover remains an important concern generating long term risk for the S2R JU activity (Establishment plan)	3
ICS4	Staff evaluation and development	Staff performance is evaluated against individual annual objectives, which fit with Shift2Rail goals and objectives. The Learning and Development Policy has been adopted by the Governing Board. Implementing procedure will be developed by HR by the end of 2018.	4
ICS5	Objective and performance indicators	Key performance indicators are in the process of establishment to help management evaluate and report on progress made in relation to their objectives. KPIs model presented to the GB with an updated version in March 2018. The final model is expected at the GB of November 2018. The expectations are to progress step by step, with new KPIs validated on an annual basis plan.	3
ICS6	Risk management process	The Shift2Rail Risk Management Policy is part of the S2R JU Governance and Process Handbook adopted by Executive Director Decision in 2017. The results of the first risk assessment 2017 have been communicated into the Annual Work Plan (AWP) 2018 and in the Annual Activity Report 2017. The JU has organised a quarterly review of main risks in 2018, of which conclusions will be reported into the AWP 2019. The Risk assessment 2018 has been initiated and it is planned to receive the support of external consultants for confirming the approach followed.	5
ICS7	Operational structure	Financial circuits: This part is considered as largely implemented. Effective ex-ante controls are in place and in respect of the Financial rules, guidance and procedure. However, additional effort should be made in some part of the process in which some minor errors have been observed. With the objective to remain constantly compliant. Sensitive function: More the aspect of the "sensitive functions" the JU has difficulties in retaining PMs in particular considering the duration and type of contracts. The revision of a document on sensitive function is planned in 2018. IT Governance: The current ICT set up which resulted in a private cloud service in place for the overall JUs provides contractually the framework for business continuity addressing one of the major shortcoming of previously having ICT infrastructure in the building.	3
ICS8	Processes and procedures	Main relevant procedures are regularly updated on the S2R website and staff members informed accordingly	5
ICS9	Management supervision	The supervisory approach of the activities is reflected in current financial approach and financial rules. The Programme Handbook has been established and is in operation since mid-2017 (with formalisation in August 2017 and adoption in October 2017). It will be subject to regular revisions.	5
ICS10	Business continuity	Considering the structure of the JU and the number of staff, the deputising approach is decided by the HoUs following the availability of staff. In addition, the Programme Handbook, complemented when needed by ad hoc procedures covers the role and responsibilities of the two Units and the working approach to the overall Programme management. A revised JU's Business Continuity Plan and Disaster Recovery Plan document is approved at technical level on 10 April 2018. Tests are foreseen in October 2018 It should be noted that from the ICT point of view the transfer to private cloud as from July 2017 of the ICT infrastructure previously in the WA building constitutes a major progress in ensuring business continuity. Consequently BCP heavily relies on the contract with the Private Cloud provider.	4
ICS11	Document management	Appropriate processes and procedures are in place to ensure that the JU's document management is secure, efficient, and complies with applicable legislation. Since the 1 June 2018, the JU has migrated to the central European Commission tool for document archiving and registration (HAN/Ares). Shift2Rail will adapt its Document Management Accordingly at Q3 2018.	4

Shift2Rail JU Internal Control assessment 2018 - AAR 2017			
Scale	*1:Not implemented - 2: partially implemented - 3: implemented - 4: largely implemented - 5:fully implemented*		
Internal Control Standard	Definition	Assessment 2018 - AAR 2017	Status
ICS12	Information and communication	Internal communication enables management and staff to fulfil their responsibilities effectively and efficiently, including in the domain of internal control. Shift2Rail has an external communication strategy to ensure that its external communication is effective, coherent and in line with the JU's key political messages (Communication Strategy adopted by Executive Director in 2017). During 2018, a new private cloud contractor will be providing the services. As a consequence, the additional business security requirement for the JU will need to be assessed with the chosen solution.	4
ICS13	Accounting and financial reporting	Adequate procedures and controls are in place to ensure that accounting data and related information used for preparing the organisation's annual accounts and financial reports are accurate, complete and timely. In 2016, the JU revised the financial information submitted to the Commission central accounting and reporting systems.	5
ICS14	Evaluation activities	Evaluations of expenditure programmes and other non-spending activities are performed to assess the results, impacts and needs that these activities aim to achieve and satisfy.	5
ICS15	Assessment of internal control systems	It was decided that the there is no need to develop specific guidelines for the review of the ICS because it is considered that the annual assessment part of the AAR preparation is in itself a formal exercise. In addition, the assessment of the ICS is part of the annual ERM approach. Finally, in addition to its own internal assessment, the JU benefits of the work performed by its auditors, IAS, ECA and the external auditors. Shift2Rail will consider in 2018 under which timeframe the new Internal Control Framework will be implemented.	4
ICS16	Internal audit function	The Internal Audit Service of the European Commission will perform the function of internal auditor of the S2R JU, in compliance with the relevant international standards. The IAS provides independent, objective assurance and consulting services designed to add value and improve the operations of the S2R JU.	5

The status of the implementation of the S2R Internal Control Framework demonstrates the relevance for the S2R JU to embed risk based management and control systems within its activities to deliver its Programme.

In this respect, the S2R JU looks forward to the implementation of the revised Internal Control Framework proposed by the European Commission.

5. MANAGEMENT ASSURANCE

5.1. Assessment of the Annual Activity Report by the Governing Board

The Executive Director submits the draft Annual Report to the S2R GB for assessment and approval. Once approved by the S2R GB, the Annual Report is made publicly available. No later than 1 July of each year the Annual Report together with its assessment shall be sent by the Executive Director to the Court of Auditors, to the Commission, to the European Parliament and the Council.

The S2R GB takes note of the results achieved and recommends the JU to continue improving its effectiveness and efficiency with the Members' stronger support.

5.2. Elements supporting assurance

In addition to the specific supervisory activities of the Executive Director, the main elements supporting the assurance are:

- the Certificate of the Accounting officer,

- the information received from the Head of R&I, the Head of Administration and Finance and the Data Protection Officer,
- the results of the audit of the European Court of Auditors,
- Internal Audit Service risk assessment,
- the overall risk management performed in 2017 as supervised by the Executive Director,
- the key performance indicators in place,
- the dedicated ex-ante controls of the JU's operational expenditure,
- the Other Members' reporting of in-kind contributions,
- the follow-up and monitoring of Call process with signature of all CFM and OC projects on time (TTG 100%),
- the exceptions reported in the "*exception and non-compliance register*" and the remedial measures put in place.

5.3. Reservations

The Executive Director is not aware of any element that would bring him to introduce a reservation in the AAR 2017.

5.4. Overall conclusion

Not applicable.

6.   DECLARATION OF ASSURANCE

I, the undersigned, Carlo M Borghini, Executive Director of Shift2Rail Joint Undertaking

In my capacity as authorising officer by delegation

Declare that the information contained in this report gives a true and fair view[22].

State that I have reasonable assurance that the resources assigned to the activities described in this report have been used for their intended purpose and in accordance with the principles of sound financial management, and that the control procedures put in place give the necessary guarantees concerning the legality and regularity of the underlying transactions.

This reasonable assurance is based on my own judgement and on the information at my disposal, such as the results of the self-assessment, ex-post controls, the work of the internal control coordinator, the observations of the Internal Audit Service and the lessons learnt from the reports of the Court of Auditors for years prior to the year of this declaration.

Confirm that I am not aware of anything not reported here which could harm the interests of the Joint Undertaking.

Brussels, 29 June 2018

....
(signature)

carlo m borghini,
Executive Director

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[22] True and fair in this context means a reliable, complete and correct view on the state of affairs in the Joint Undertaking.

7. ANNEXES[23]

ANNEX A Organisational chart of the S2R JU

Executive Director

Programme Office

Head of Research & Innovation

Head of Admin & Finance

Internal Control and Quality [1 FTE]*

Human Resources [1 FTE]

Communication & Stakeholders' Relationships [1 FTE]

ED Assistant [1 FTE]

Programme Management [6 FTE:
- one per each of the 5 IPs
- CCA*]

Legal Support - Grants [1 FTE*]

Programme Management Support [1 FTE]

Budget and Finance [2+1* FTE]

Legal [1 FTE]

ICT [1 FTE]

Administrative and Financial Support [1 FTE*]

The present Organisation Chart, adopted by the S2R GB on 25 October 2016, included 4 posts (1 TA and 3 CAs) that became available on 1 January 2017 following the adoption of the 2017 Union Budget.

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[23] It should be noted that the Annexes related to publications from Projects, patents from Projects, materiality criteria are not included considering that the Projects' activities started only 1 September 2016.

ANNEX B Establishment plan

Function group and grade	Temporary agents					
	2015		2016		2017	
	Authorised under the EU Budget	Filled as of 31/12/2015	Authorised under the EU Budget	Filled as of 31/12/2016	Authorised under the EU Budget	Filled as of 31/12/2017
	Temporary posts	Temporary posts	Temporary posts	Temporary posts	Temporary posts	Temporary posts
AD 16						
AD 15						
AD 14	1		1	1	1	1
AD 13						
AD 12						
AD 11						
AD 10						
AD 9	2		2	1	2	2
AD 8	1		1			
AD 7		1		1	1	1
AD 6					1	1
AD 5		1		1		
AD TOTAL	4	2	4	4	5	5
AST 1-11						
AST TOTAL						
AST/SC 1-6						
AST/SC TOTAL						
TOTAL	4	2	4	4	5	5
GRAND TOTAL	4	2	4	4	5	5

Contract agents	Authorised 2015	Filled as of 31/12/2015	Authorised 2016	Filled as of 31/12/2016	Authorised 2017	Filled as of 31/12/2017
Function Group IV	5	4	7	8	11	9
Function Group III	3	2	3	3	3	5
Function Group II	2	2	3	2	2	1
Function Group I						
TOTAL	10	8	13	13	16	15

Seconded National Experts	Authorised 2015	Filled as of 31/12/2015	Authorised 2016	Filled as of 31/12/2016	Authorised 2017	Filled as of 31/12/2017
TOTAL	0	0	2	0	2	0

ANNEX C Indicators and Scoreboard of KPIs

TABLE I - Horizon 2020 Key Performance Indicators[24] common to all Jus

	Corresponde nce 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	Automa ted	Result 2017
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	17%
	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	N.A.
SOCIETAL CHALENGES	14*	Publications in peer-reviewed high impact journals in the area of the JU	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	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	10

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

Corresponde nce 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	Automa ted	Result 2017
			bibliometric databases.					
15*	Patent applications and patents awarded in the area of the JU	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	0
16*	Number of prototypes testing activities and clinical trials	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	24
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	9
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	80

	Corresponden ce 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	Automa ted	Result 2017
EVALUATION	NA	Time to inform (average time in days) <u>all applicants</u> 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	H2020		Yes	76
	NA	Time to inform (average time in days) <u>successful applicants</u> of the outcome of the evaluation of their application from the final date for submission of completed proposals		Number of days (average)	Joint Undertaking	H2020		Yes	76
	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	H2020			none
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)	H2020		Yes	185
	NA	Time for signing grant agreements from the date of informing successful applicants (average values)		Average under H2020 (days)	Joint Undertaking	H2020		Yes	102

	Corresponden ce 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	Automa ted	Result 2017
AUDITS	NA	Error rate		% of common representative error; % residual error	CAS	H2020		Yes	1.6%; 1.44% for the H2020 research family
	NA	Implementation of ex-post audit results		Number of cases implemented; in total €million; ´of cases implemented/total cases	CAS	H2020		Yes	N.A.

	Corresponden ce 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	Automa ted	Result 2017
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	H2020	-pre-financing (30 days) - interim payment (90 days) -final payment ((90days)	Yes	Operational: Pre-financing: 100% Average number of days: 24 Interim/final: 92.3% Average number of days: 86 Administrative: Pre-financing: N/A Interim/final: 96.3% Average number of days: 14 Number of experts appointed: 25

	Corresponden ce 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	Automa ted	Result 2017
HR	NA	Vacancy rate (%)		% of post filled in, composition of the JU staff [25]	Joint Undertaking	H2020			87%
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	H2020	100% in CA and 90% in PA	Yes	100% in CA 82.6% in PA
	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		H2020	Yes	24 late payments 3.7%

NOTES:

12,14,15,16,17,18*: The upcoming Control Gates (April) and project Reviews could generate improved data for this KPI which is cumulative on the S2R running projects in 2017.
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.

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

TABLE II - Indicators for monitoring H2020 Cross-Cutting Issues26 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	Result 2017
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	**At the submission:** 454 participations from 25 EU Member states, of which 451 participation eligible from 24 EU Member states with 346 single applicants **In the signed grant agreements:** 253 (LTP Included) Beneficiaries from 16 Member states 193 (LTP excluded) Beneficiaries from 16 Member states
		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	59.3 M € from 16 Member states
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	**At the submission:** 10 applicants from 4 countries **In the signed grant agreements:** 2 Beneficiaries from 1 countries
NA		Total amount of EU financial contribution	Nationality of H2020 beneficiaries and	H2020 beneficiaries at grant agreement signature stage	JU AAR RTD	YES	Yes	1 Candidate country beneficiary of 0.09 M€

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26 (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	Result 2017
		by Candidate Country (EUR millions)	corresponding EU financial contribution		Monitoring Report			
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	60 Beneficiaries are SMEs and they benefit of 18.9% of the total contribution
6	Gender	6.1 Percentage of women participants in H2020 projects	Gender of participants in H2020 projects	H2020 Beneficiaries through project reporting		YES	Yes	12.6% of applicants 20% among beneficiaries
		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	17.6%
		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		• **S2R JU Governing Board** : 10% of representatives are female in the GB members only and 13% including alternates • **S2R JU States Representatives Group** 35% of representatives are female • **S2R JU Scientific Committee** : 33% of members are female

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	Result 2017
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	NO	Yes	0%
		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	NO	Yes	0%
9	Bridging from discovery to market [27]	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	11.8% (share of projects) 8.8% (share of financial contribution)
		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	100% follow up as per Grant Agreement

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[27] 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	Result 2017
NA		Scale of impact of projects (High Technology Readiness Level)	Number of projects addressing TRL[28] between…(4-6, 5-7)?	Joint Undertaking	JU AAR RTD Monitoring Report			TRL 4-6 (incl. projects up to TRL 4): 14 TRL 5-7: 4 Total: 17
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	161 beneficiaries 61.7% of the total beneficiaries
		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	68.6%
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	60.1 M€
		12.2 PPPs leverage: total amount of funds leveraged through Art. 187 initiatives, including additional	Total funding made by private actors involved in PPPs - in-kind contribution already committed by	Joint Undertaking Services	JU AAR RTD Monitoring Report			157% **225%** considering only the S2R Members

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[28] 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	Result 2017
		activities, divided by the EU contribution	private members in project selected for funding - additional activities (i.e. research expenditures/investment of industry in the sector, compared to previous year)					certification process ongoing
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	273 Dissemination and outreach activities other than peer-reviewed publications 25.429 persons reached
14	Participation patterns of independent	14.2 Proposal evaluators by country	Nationality of proposal evaluators	Responsible Directorate /Service/Joint Undertaking in charge with the management of proposal evaluation				25 experts (24 from 12 EC Member States + 1 from Associated Countries)
		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				Extract from S2R Experts Pool statistics

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	Result 2017
								Others : 18% Private / Commercial Research Centres : 4% Non-research Public Sector : 9% Non-research Commercial sector including SMEs : 8% Higher Education Establishments : 30% Public Research Centres : 4% Non-research International Organisations (Association of States) : 3% Consultancy firms : 16% NONE : 8%
NA	Participation of RTOs and Universities	Participation of RTO[29]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	30 participations of RTOs 11.5% of total 37 participations of Universities 14.2% of total BUDGET - 24%

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[29] RTO: Research and Technology Organisation

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	Result 2017
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)[30]	Responsible Directorate /Service/Joint Undertaking	JU AAR RTD Monitoring Report			0%

Notes:

*H2020 applicants - all those who submitted H2020 proposals

*H2020 beneficiaries - all those who have signed a H2020 Grant Agreement

13*: The upcoming Control Gates (April) and project Reviews could generate improved data for this KPI which is cumulative on the S2R running projects in 2017.

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	Result 2017
S2R							

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[30] Data relates to pre-granting ethics review. This time span runs in parallel to granting process.

#	Key Performance Indicator	Objective	Data to be provided by	Baseline at the start of H2020	Target at the end of H2020	Automated	Result 2017
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	*
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	*

#	Key Performance Indicator	Objective	Data to be provided by	Baseline at the start of H2020	Target at the end of H2020	Automated	Result 2017
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	*

* as indicated, a S2R JU KPI model is under development and any available data will be uploaded by the final version of this AAR.

ANNEX D Annual accounts

BALANCE SHEET

EUR '000

	Note	31.12.2017	31.12.2016
NON-CURRENT ASSETS			
Property, plant and equipment	2.1	*264*	*284*
Pre-financing	2.2	*30 064*	*34 026*
		30 328	**34 310**
CURRENT ASSETS			
Pre-financing	2.2	*36 502*	*6 773*
Exchange receivables and non-exchange recoverables	2.3	*9 647*	*9 795*
		46 149	**16 567**
TOTAL ASSETS		**76 477**	**50 877**
CURRENT LIABILITIES			
Payables and other liabilities	2.4	*(36 770)*	*(4 737)*
Accrued charges	2.5	*(28 770)*	*(6 310)*
		(65 541)	**(11 047)**
TOTAL LIABILITIES		**(65 541)**	**(11 047)**
NET ASSETS		**10 936**	**39 831**
NET ASSETS			
Contribution from Members	2.6	*89 241*	*51 755*
Accumulated deficit		*(11 925)*	*–*
Economic result of the year		*(66 381)*	*(11 925)*
NET ASSETS		**10 936**	**39 831**

STATEMENT OF FINANCIAL PERFORMANCE

EUR '000

	Note	2017	2016
REVENUE			
Revenue from non-exchange transactions	3.1	**–**	**370**
Total revenue		**–**	**370**
EXPENSES			
Operating costs	3.2	*(63 366)*	*(10 564)*
Staff costs	3.3	*(1 364)*	*(651)*
Other expenses	3.4	*(1 651)*	*(1 079)*
Total expenses		**(66 381)**	**(12 295)**
ECONOMIC RESULT OF THE YEAR		**(66 381)**	**(11 925)**

CASHFLOW STATEMENT[31]

EUR '000

	2017	2016
Economic result of the year	*(66 381)*	*(11 925)*
Operating activities		
Amortization and depreciation	*48*	*23*
Cash contribution from Members	*34 476*	*51 755*
(Increase)/decrease in pre-financing	*(25 767)*	*(40 798)*
(Increase)/decrease in exchange receivables and non-exchange recoverables	*147*	*(9 795)*
Increase/(decrease) in payables	*32 034*	*4 737*
Increase/(decrease) in accrued charges	*22 460*	*6 310*
Increase/(decrease) in in-kind contribuions	*3 010*	*–*
Other non-cash movements	*-*	*(284)*
Investing activities		
(Increase)/decrease in intangible assets and property, plant and equipment	*(28)*	*(23)*
NET CASHFLOW	**–**	**–**
Net increase/(decrease) in cash and cash equivalents	*–*	*–*
Cash and cash equivalents at the beginning of the year	*–*	*–*
Cash and cash equivalents at year-end	*–*	*–*

STATEMENT OF CHANGES IN NET ASSETS

	Contribution from Members	Accumulated Surplus/ (Deficit)	Economic result of the year	Net Assets
BALANCE AS AT 31.12.2015	**–**	**–**	**–**	**–**
Cash contribution	*51 755*	*–*	*–*	*51 755*
Economic result of the year	*–*	*–*	*(11 925)*	*(11 925)*
BALANCE AS AT 31.12.2016	**51 755**	**–**	**(11 925)**	**39 831**
Allocation 2016 economic result	*–*	*(11 925)*	*11 925*	*–*
Cash contribution	*34 476*	*–*	*–*	*34 476*
Contribution in-kind	*3 010*	*–*	*–*	*3 010*
Economic result of the year	*–*	*–*	*(66 381)*	*(66 381)*
BALANCE AS AT 31.12.2017	**89 241**	**(11 925)**	**(66 381)**	**10 936**

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[31] Following the appointment of the Accounting Officer of the Commission as the Accounting Officer of S2R JU, the treasury of S2R JU was integrated into the Commission's treasury system. Therefore, S2R JU does not have any bank accounts of its own. All payments and receipts are processed via the Commission's treasury system and registered on intercompany accounts which are presented under the heading exchange receivables.

ANNEXE E LIST OF ACRONYMS

Abbreviation	
ABAC	Accrual Based Accounting
ATO	Automated Train Operation
AWP	Annual Work Plan
AAR	Annual Activity Report
CA	Commitment Appropriation
CAPEX	Capital Expenditure
CBM	Condition-Based Maintenance
CCA	Cross Cutting Activities
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CFM	Call for Members
CSA	Coordination and support action
DOI	Digital Object Identifier
DRIMS	Dynamic Railway Information Management System
EC	European Commission
ED	Executive Director
EN	European Norm
ERRAC	European Rail Research Advisory Council
ERTMS	European Rail Traffic Management System
ETCS	European Train Controlling System
EU	European Union
ERA	European Union Agency for Railways
FACTs	Flexible AC Transmission Systems
FFFIS	Form Fit Functional Interface Specifications
FIS	Functional Interface Specifications
GA	Grant Agreement
GIS	Geographic Information System
GNSS	Global Navigation Satellite System
GoA	Grade of Automation
H2020	Horizon 2020, EU framework programme for Research and Innovation
IA	Innovation Action
ICT	Information and Communications Technology
IEC	International Electrotechnical Commission
IKAA	in-kind contributions to additional activities
IP	Innovation Programme
IPR	Intellectual Property Rights
ISO	International Standardisation Organisation
IT	Information Technology
ITD	Integrated Technology Demonstrator
JTI	Joint Technology Initiative

JU	Joint Undertaking	
KPI	Key Performance Indicator	
LCC	Life Cycle Cost	
LIDAR	Light Detection and Ranging	
LTE	Long-Term Evolution (standard for wireless communication)	
MAAP	Multi-annual Action Plan	
MB	Moving block	
NLOS	non-line-of-sight	
NTP	Network Time Protocol	
OC	Open Call	
ODM	Operational Data Management	
OPEX	Operating Expenditure	
PA	Payment Appropriation	
R&I	Research and Innovation	
PPP	Public Private Partnership	
PRM	Persons with Reduced Mobility	
PTC	Positive Train Control	
PTI	Platform Train Interface	
RAL	Unpaid amount	
RAMS	Reliability and Maintainability System	
RBC	Radio Block Centre	
RFID	Radio Frequency Identification	
RIA	Research and innovation action	
RoI	Return of Investment	
S2R	Shift2Rail	
SC	Scientific Committee	
SME	Small and Medium Enterprise	
SNE	Seconded National Expert	
SPD	System Platform Demonstration	
SRG	States Representatives Group	
SWL	Single Wagon Load	
TAF	Telematic Application for Freight	
TAP	Telematic Application for Passengers	
TCMS	Train Control and Monitoring System	
TC	Tender Call	
TD	Technology Demonstrator	
TL	Train Load	
TMS	Traffic Management System	
TRL	Technology Readiness Level	
TSI	Technical Specifications for Interoperability	
UAV	Unmanned Aerial Vehicle	
WA	Work Area	