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Shift2Rail
moves into full gear

With 56 research proposals submitted for funding under the first call for proposals the European Shift2Rail joint technology inititative is finally starting to gain momentum.

Academic research bodies and industry partners will be working together on various Shift2Rail projects

Over the next couple of months, the first batch of projects to benefit from EU funding under the Shift2Rail research and innovation programme will be selected, and start to get underway.

This pan-European joint technology initiative has been a long time gestating since the initial Declaration of Intent was signed by a group of UNIFE member companies on July 1 2011 (RG 1.12 p38). The idea was to establish a 'more appropriate structure for industry-wide research' during the EU's 2014-20 budget period, both to help meet the European Commission's 2050 goals for the rail sector and to enhance the competitiveness of the European railway supply industry.

After much discussion, the Regulation establishing the Shift2Rail Joint Undertaking was published by

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the Commission in December 2013 and adopted by the EU's Council of Ministers on June 16 2014 (RG 7.14 p12). The JU was legally established as an EU body the following month, becoming the first European Public Private Partnership specifically tasked with leading strategic research in the rail sector.

The nine founding members — including the EU itself — were subsequently joined by Associate Members selected through an open call launched in October 2014 (Table I). These were selected following an assessment of the contribution they could make to the objectives laid down in the Shift2Rail Regulation.

Shift2Rail has a total budget of €920m. Of this, €450m is coming from the EU's Horizon 2020 research programme and the remainder will be co-financed by the members and other industry partners.

When launched in 2014, the JU was

expected to be 'functionally independent' by early 2015, but it has taken longer than envisaged to get up and running. A key milestone was reached on February 16 this year, with the appointment of Carlo Borghini as Executive Director (p35). He is due to take up his post this month, succeeding Keir Fitch, the Head of Unit for Research at DG Move, who has been serving as Interim Executive Director.

Master Plan

The JU is responsible for co-ordinating, managing and integrating the various EU-approved research and development projects that will be pursued over the next five or six years. These will be undertaken by the Founding Members, Associate Members and third parties.

The overall research strategy is laid out in the Shift2Rail Master Plan, which was endorsed by the Council on February 10 2015. This confirms the three ambitious targets set out in the initial proposals:

- to cut the life-cycle cost of rail transport by up to 50%;
- to double railway capacity; and
- to increase reliability and punctuality

Table I. Shift2Rail Members

* European Union
AᴇʀFɪᴛᴇᴄ consortium
* Alstom
Amadeus IT Group
* Ansaldo STS
AZD Praha
* Bombardier Transportation
CFW consortium (Competitive Freight Wagon)
* Construcciones y Auxiliar de Ferrocarriles
Deutsche Bahn
Diginext
Eᴜʀᴏᴄ consortium (European Rail Operating Community)
Faiveley Transport
HaCon Ingenieurgesellschaft
Indra Sistemas
Kapsch CarrierCom
Knorr-Bremse
MerMec
* Network Rail
* Siemens
Smart DeMain consortium
Smart Rail Control consortium
SNCF
Swi'Tracken consortium
Patentes Talgo
* Thales
* Trafikverket
VVAC+ (Virtual Vehicle Austria consortium)
* Founding members

by as much as 50%.

These objectives are to be pursued through five themed Innovation Programmes:

IP1 (*Cost-Efficient & Reliable Trains*) covers rolling stock development, including both high speed and high-capacity trains (Fig 1);

IP2 (*Advanced Traffic Management & Control Systems*) focuses on signalling and train control;

IP3 (*Cost Efficient and Reliable High Capacity Infrastructure*) will be looking at many different aspects of infrastructure, from the holistic system approach (Fig 2) down to individual structures and track components such as turnouts;

IP4 (*IT Solutions for Attractive Railway Services*) will look at many differernt applications of information technology from ticketing and passenger information through to operations and maintenance strategies;

IP5 (*Technologies for Sustainable & Attractive European Rail Freight*) is intended to look at all aspects of the freight task, in order to help rail play a greater role in the evolving European transport market.

In addition, there will be a range of **Cross-Cutting Activities** designed to further the integration of railways as a system.

DIRECTOR
Time to get started

'Shift2Rail is no longer in the set-up phase', insists Carlo Borghini, the newly-appointed Executive Director of the Joint Undertaking. 'We are operational, and moving towards the launch of the implementation activities.'

Appointed by the JU governing board on February 16, Borghini takes up his post this month. He brings experience in running large scale research programmes, as well as European agencies and feels that his experience in different industries will help to ensure the 'sound implementation' of the five Innovation Programmes.

Borghini graduated in Business Economics from Milano's Bocconi University in 1990, and worked for various private companies in the finance sector, including SO.PA.F Group and American Express Bank. He then joined the European Commission as Head of the Internal Audit Unit in the Directorate General for Budget.

In 2008 Borghini was appointed Deputy Executive Director for the Sᴇsᴀʀ (Single European Skies Advanced Research) Joint Undertaking covering the aviation sector. With specific responsibilities for corporate governance, administration and finance, he managed a research budget amounting to more than €2bn, and a portfolio of more than 300 different projects undertaken by the 16 SJU members. In July 2014, he moved to the European Defence Agency as Corporate Services Director, responsible for the management of financial and human resources, as well as administrative issues.

'Shift2Rail is Europe's most ambitious programme of research in the rail sector', says Borghini, adding that it is 'vital to ensuring the long term competitiveness of the industry and to delivering sustainable transport in Europe'. He believes that 'the enhanced synergies of a Public-Private Partnership are motors for innovation and the prospects are very exciting.

'Shift2Rail is jointly owned by the EU and industry. This programme is vital at a European level and the IPs identified in the Master Plan will build on the reforms envisaged in the Fourth Railway Package. As well as encouraging competition and innovation in domestic passenger markets, this legislation will implement structural and technical reforms, leading to higher levels of safety, interoperability and reliability in the European rail network. Making rail more attractive for passengers and freight shippers is essential to reach our ambitious transport decarbonisation objectives.'

Borghini points to Eʀᴛᴍs as 'a prime example of how the European rail sector can drive innovation and support the creation of a harmonised railway area, improving efficiency, while opening up significant business opportunities for the European rail industry, both in and outside the EU.'

'Since my appointment, I have started meeting with the key stakeholders in the European rail industry and listened to their concerns. Our primary objective is to implement what we aim to deliver and to start work in each IP. As you can see from our targets there is a lot of work to do, so let's get started!' ■

Lighthouse projects

While the JU was being established, the European Commission agreed to move ahead with a series of so-called 'lighthouse' projects, which would bridge the gap between the research work supported by the previous Framework Programme 7 and the S2R Innovation Programmes. Following a call for proposals, €52m was awarded to four 30 or 36-month projects, which were launched in May 2015 (RG 6.15 p63).

In2Rail is setting the foundations for a resilient, consistent, cost-efficient and high-capacity European rail network. It will feed into IP2 and IP3, helping to deliver smart infrastructure, intelligent mobility and improved energy management.

IT2Rail forms the first step towards IP4. The introduction of 'radical new technologies and solutions', is expected to transform users' global travel interactions into a 'fully integrated and customised experience'. The long-term aim is to make the entire European transport system a natural extension of people's work and leisure environments, across all modes, local and long-distance, public and private.

Roll2Rail is kicking off many of the initiatives to be continued in IP1. It is looking to develop key technologies and help overcome hurdles to innovation in rolling stock development.

Smart Rail focuses on rail freight improvements as a prelude to IP5. It covers five aspects that are important to freight shippers: reliability, lead time, costs, flexibility and visibility. The project is looking to test a range of proposals on three so-called Continuous Improvement Tracks, along specified rail corridors.

In addition to the lighthouse projects,

Fig 1. IP1 will be looking at a range of technologies to improve future generations of rolling stock.
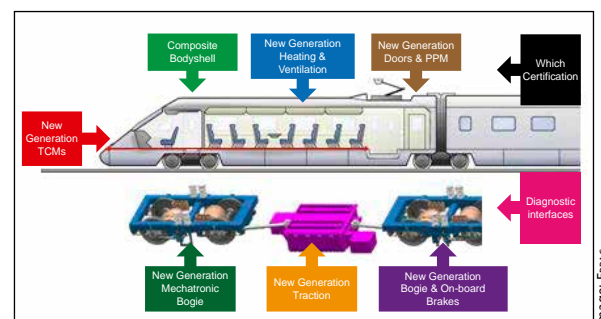
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Fig 2. Advanced modelling of the track structure and track-train forces will support the development of cost-effective and high-performance rail infrastructure under IP3.

since the beginning of 2016, the JU members have been able to start some additional activities to support the Shift2Rail work programme.

Initial calls

Following the adoption of the Shift-2Rail Multi-Annual Action Plan and the Annual Work Plans for 2015 and 2016, the JU published its first calls for proposals in December 2015. These cover research and innovation activities to be conducted over the next 36 months with an estimated value of €170m, co-financed by the EU up to €90m. Some are reserved for the JU members and others are open calls for outside participants.

Announcing the results on March 30, the JU expressed 'broad satisfaction' with the response. No fewer than 56 proposals with a nominal value of €222m had been submitted (Table II). These represented a total of 454 participating organisations, of which 25% were SMEs. Analysis of the proposals began in April, and the process is due to be completed by the end of
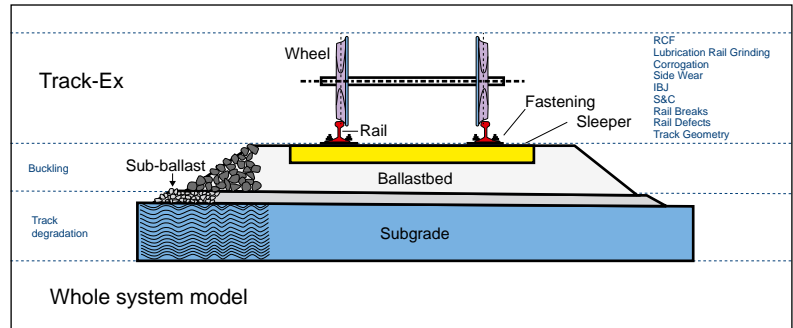
June; the applicants will be informed by mid-July. The selected projects are expected to begin by December at the latest, but some may be getting underway sooner.

Of the 56 proposals, 13 came from the 27 JU members, requesting a total of €63m, to which the members are planning to contribute a further €80m. The 15 open call topics attracted 43 proposals seeking funding close to €80m against an available budget of just €26·1m.

According to Interim Executive Director Keir Fitch, 'the application rate for the open calls should ensure that we have healthy competition in most of the topics. We are confident that this will result in the JU funding excellent projects in all its Innovation Programmes. We are particularly enthusiastic to see the high participation rate of SMEs.' As representative of the founding members, Network Rail's Andy Doherty added that the JU was 'confident' that the selected projects would 'complement the work already launched under the lighthouse projects'.

The initial call covers a mix of projects in each of the IP areas as well as cross-cutting activities.

Within IP1, there are projects looking at advanced traction systems such as silicon carbide semiconductors, as well as new architectures for train control and monitoring, train-to-ground communications and electronic braking.

The IP2 projects initially focus on automation, high-capacity radio communications, and safe train separation; these offer the prospect of improved functionalities and standardised interfaces, helping to facilitate the migration from legacy systems and to decrease overall costs. Another project will address the growing issue of cyber security.

Early IP3 activities are taking a whole-system approach to track, switches and crossings in order to optimise capacity. Work in the structures area will look at ways to extend the life of bridges and tunnels. The aim is to find more holistic, intelligent and consistent ways of maintaining assets, using lean operational practices and smart technologies.

Passenger-centric projects in IP4 will be looking to develop a suite of applications to support a 'one-stop shop' selling transport products and related services across different modes. These will offer real-time travel planning and information, including support in the event of disruption. Research will also look at the development of a multi-modal market place supported by an interoperable 'semantic web'.

Among the initial projects in IP5 will be a range of freight-related research,

Table II. Shift2Rail initial calls

Member calls	Topic	Proposals
IP1-01	Development of concepts towards the next generation of traction systems and management of wheel/rail adhesion	1
IP1-02	Development of new technological concepts, standard specifications and architectures for train control and monitoring, with specific applications in train-to-ground communications and high safety electronic control of brakes	1
IP2-01	Start-up activities for advanced signalling and automation system	1
IP3-01	Research into enhanced track and switch and crossing system	1
IP3-02	Intelligent maintenance systems and strategies	1
IP4-01	Shopping, booking and ticketing of multimodal travel solutions	1
IP4-02	Travel companion and tracking services	1
IP5-01	Development of functional requirements for sustainable and attractive European rail freight	1
IP5-02	Start-up activities for freight automation	1
IP5-03	Freight Propulsion concepts	1
CCA-01	Start-up activities for System Platform Demonstrator integrated assessment and socio-economic effects	1
CCA-02	Energy and sustainability, including noise and vibrations baselines assessment	1
CCA-03	Integrated mobility and safety management	1
Open calls	**Topic**	**Proposals**
IP1-01	Tools and methodologies supporting the development of next generation traction systems, and brakes	0
IP1-02	Technology feasibility studies supporting the development of next generation TCMS, and safe control for brakes	3
IP2-01	Threat detection and profile protection definition for cyber security assessment	3
IP2-02	IT virtualization of testing environment	2
IP2-03	Technical specifications for a new adaptable communication system for all railways	1
IP3-01	Research into new radical ways of changing trains between tracks	4
IP4-01	Interoperability framework governance, ensuring its market uptake and sustainability	2
IP4-02	Interoperability framework converters	1
IP5-01	Freight automation on lines and in yards	3
IP5-02	Improved vehicle/train dynamics	3
IP5-03	Intelligent freight wagon with predictive maintenance	7
CCA-01	Long-term needs of different actors in the railway sector	3
CCA-02	Energy usage, generation and saving approaches	3
CCA-03	Noise reduction methodologies	4
CCA-04	Safer infrastructure – improved object detection and prevention of safety critical events and integrated mobility	4

including greater automation and the testing of autonomous freight trains. Particular attention will be paid to noise and life-cycle costs, improved freight locomotives, driver advisory systems, and the operation of longer freight trains. A key aim is to address the challenge of last-mile connectivity in the overall distribution chain. Other concepts to be investigated include intelligent wagons with predictive maintenance, especially for perishable, dangerous or expensive goods, and low-cost tracking and tracing systems.

The Cross-Cutting Activities will start by defining the socio-economic factors that can contribute to a more attractive railway, and consider how these relate to the Innovation Programmes. Looking at preferences, behaviours and lifestyles will help the industry to identify the main influencing factors, from mega-trends to evolving customer requirements.

Technology demonstrators

The Multi-Annual Action Plan also envisages the development of tools and approaches to evaluate the potential impacts of the various technologies resulting from the different research initiatives.

Shift2Rail is funding various types of research, designated as Co-ordination & Support Actions, Research Innovation Actions and Innovation Actions. The aim is to conclude with demonstration projects up to a Technology Readiness Level of 6 or 7 as defined under Horizon 2020 (Table III).

Demonstration activities are a priority, as they will enable the entire rail sector to visualise and test the concepts. The demonstration phase will be based on a three-level architecture (Fig 3).

The Technology Demonstrators will enable a more appropriate quantification of the impact of each new technology, either alone or in combination through the Integrated Technology Demonstrators. The aim is to encourage a more collaborative system approach toward innovation, breaking down the possible silos between subsystems. This approach will also help to identify any possible compatibility issues at an early stage.

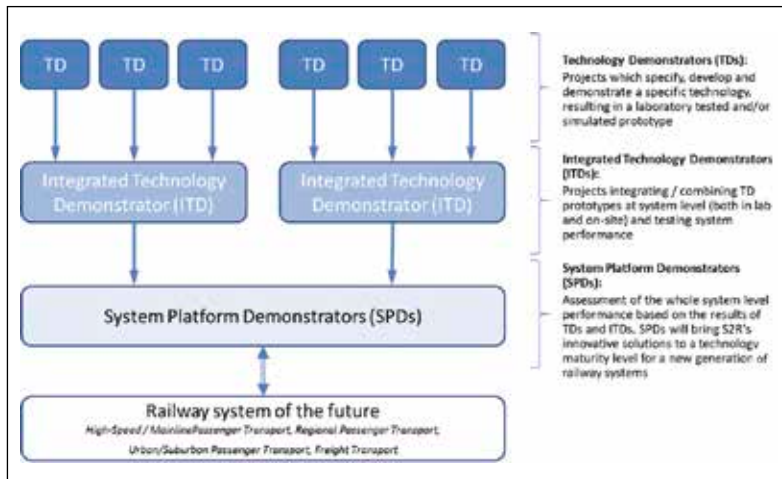| Table III. Horizon 2020 Technology Readiness Levels	
TRL 1	Basic principles observed
TRL 2	Technology concept formulated
TRL 3	Experimental proof of concept
TRL 4	Technology validated in laboratory
TRL 5	Technology validated in relevant environment
TRL 6	Technology demonstrated in relevant environment
TRL 7	System prototype demonstration in operational environment
TRL 8	System complete and qualified
TRL 9	Actual system proven in operational environment

The System Platform Demonstrators will compare the various activities against the system-level targets in the Master Plan. There will also be a 'transversal evaluation' to look at energy, noise and vibration issues.

Shift2Rail is taking an integrated approach to railway safety and security, with integrated planning to consider the interdependencies in the railway system.

In order to support this systems approach, a number of call topics and future projects for both members and non-members were included in the first calls as 'complementary contributions'. These will facilitate the sharing, integration and future exploitation of the results. The project results will also be shared with European Railway Agency, which holds an advisory role in the JU, with a view to ensuring future interoperability as well as safety.

Looking to the future, the JU is preparing to scale up its activities, and launch additional calls for proposals and tenders. It will also ensure adequate funding for the projects that will contribute to achieving the Master Plan targets as they evolve. ■

Technology Demonstrators (TDs): Projects which specify, develop and demonstrate a specific technology, resulting in a laboratory tested and/or simulated prototype

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

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

Left: Fig 3. A series of Technology and System Platform demonstrators will help to evaluate the potential impact of and interaction between the concepts being developed in each programme.