FOSTER-RAIL The Future Of Surface Transport Research - Rail



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Introduction

The European Commission funded FOSTER-RAIL project – which ran from 1 May 2013 until 31 April 2016 – was implemented in order to support the work of the European Rail Research Advisory Council (ERRAC). It addressed the challenge to strengthen and support research and innovation and to enhance the coordination among main stakeholders and actors on the European level as well as between the European and national levels. It integrated the work done so far by ERRAC and its working groups' outcomes, such as the RailRoute 2050 and the Strategic Rail Research Agenda (SRRA) and other reports (see www.ERRAC.org).

Starting with the already published deliverables of the former EU project ERRAC-ROADMAP, the FOSTER-RAIL project continued to coordinate the research and innovation agenda and priority setting process among the wide range of relevant stakeholders in the rail sector.

This brochure illustrates the outcomes of FOSTER-RAIL project and will hopefully raise the interest of the other European rail stakeholders, whether they will be railway operators, infrastructure managers, manufacturing industry, researchers or customers and users of the freight or passenger related services of the European railway systems in order to support the much needed innovation of this safe and comfortable mode of transport and its connections with the other modes of transport.

The work carried out in the FOSTER-Rail project allowed to produce the new Strategic Rail Research and Innovation Agenda (SRRIA) and specific Rail Technology & Innovation Roadmaps aiming at 2050.

The output is meant to be used by the European Commission in developing their future Horizon 2020 Work Programmes and Calls and hopefully also will serve as input for the Shift2Rail Joint Undertaking and their Annual Plans and Calls as well as to other transport related research and innovation programmes. The FOSTER-RAIL project structure looked as follows:



COOPERATION, COMMUNICATION & COORDINATION WITH OTHER ETPS AND NATIONAL TECHNOLOGY PLATFORMS

WP1 produced 3 Reports.

The first report is specifically dedicated to the support of the rail stakeholders gathered in ERRAC in relationship with the other surface transport European Technology Platforms.

These surface transport European Technology Platforms (ETPs) - ERRAC, ERTRAC and WATERBORNE – have already developed roadmaps for European research, the most updated versions of which have been published on their websites in 2013. Moreover, ALICE ETP, recognized as such in July 2013, has delivered the research roadmaps for the Logistics sector later.

WP1

The three ETPs have each been granted in 2013 new Cooperation and Support Actions (CSA), namely FOSTER-RAIL, FOSTER-ROAD and MESA FOSTER-WATERBORNE for updating their work. In addition the ALICE CSA, WINN, started in October 2012. A particular feature of the four CSAs is that they all include a common set of tasks regarding ETPs Cooperation, Communication and Coordination.

The four ETPs met several times in face to face meetings or through conference calls to review the current structure and organization of each ETP, as well as the current status of their cooperation. They clustered topics of common interest and agreed upon – and started running - a set of coordinated actions. They identified potential participants for the joint works, which shall be completed regularly.

Due to the different timescales of the three projects, to the publication at the end of 2013 of the Research and Innovation Work Programme HORIZON 2020, and to the agreed planning of works, the ETPs decided that a delivery of their cooperation report by mid-2014 would be more appropriate. It had also been decided that the report - which had been renamed "Clustering multi-modal research and innovation issues between ETPs" - would be prepared jointly by the three ETPs, even though the overall presentation of the report might slightly differ for each CSA, since each CSA has its own template for deliverables. The FOSTER-RAIL deliverable D1.1 summarised the joint ETPs initiatives developed in the recent past or agreed for the very near future.

The second task within this work package produced 2 reports – a preliminary and a final version – on "Developing links and coordination strategies between ERRAC, EU and National Technology Platforms". The 1st one described the state of the art, while the second one gave recommendations for reinforcing the links and coordination for the future. The first (intermediate) report, D1.2, dealt with 2 different issues. On the one hand, it sought to identify the existence and organisation of a national equivalent to the European Technology Platform (ETP), e.g. a National Technology Platform (NTP) in one form or another. On the other hand, it attempted to map and analyse the European national transport policies, the national research priorities. The project results highlighted some clear patterns in national transport policies and research priorities as some common functioning features between the 8 NTPs which have been identified.

The final report, D1.4, is taking into account the state-of-the-art developed in D1.2, and evaluates the ERRAC relationships with numerous stakeholders of railway research and innovation in the Member States and Associated States (MS/AS). It also proposes recommendations to ERRAC and EC in order to create synergies with the identified research coordination bodies existing at national level in MS/AS to ensure the uptake of the FOSTER-RAIL project outcomes. This deliverable also describes ERRAC relations with TRIP (the Transport Research and Innovation Portal), the UIC Railway-Research Portal, the other ETPs, the relevant ERA-NETs and Joint Undertaking Shift2Rail - giving recommendations for an even more effective cooperation and information exchange. To deliver its conclusions in a clear and consistent manner, this D1.4 deliverable is divided into two parts.

RAIL BUSINESS SCENARIOS

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WP2 dealt with 2 different issues: on the one hand the development of several Rail Business Scenarios and determining the most probably scenario upon which to build the SRRIA and the Technology Roadmaps and on the other hand the update of the previously (2006) developed ERRAC report the "Suburban and Regional Rail Market Analysis".

D2.6 presents the second outline and update of the initial reference rail business scenario. The first outline was developed and agreed upon in the FOSTER-RAIL Futures Dialogue Forum in March 2014 in Brussels. A forward looking exercise was organised involving a broad range of stakeholders and experts representing the European rail community: rail industry, rail operators, rail infrastructure managers, rail research and academia and rail related public policy and civil society actors. The scenario was taken into account when drafting and agreeing upon the roadmaps in WP4 of FOSTERRAIL.

To achieve an update of the initial reference scenario the reference rail business scenario was reframed and complemented by additional key aspects and storylines. The outcome of several other forward lookingand scenario exercises related to the rail and transport sector including a range of documents of particular rail stakeholder groups were analysed and the outcome compared to the outcome of the initial business reference scenario.

Additional storylines and key aspects were introduced into the business reference scenario. In particular the normative starting point was reframed asking the question how a European rail system of the future should look like, when a strict climate regime is implemented in Europe and globally, what means the transport sector has to be nearly fully decarbonised till 2050 and beyond. The major storylines of the updated rail business reference scenario can be summarized as follows.

At the United Nations Framework Convention on Climate Change (UNFCCC) climate negotiations in Paris (COP21), it was politically decided to achieve a very low carbon economy no later than 2050. Climate and environmental concerns and a common global understanding that technological and societal progress has to be taking place within planetary boundaries have succeeded the political debate. The post-COP21 (Paris) climate regime framework gives a definitive impulse towards a next industrial transformation.



Under the changing framework of the post Paris climate regime, global trade has to be reorganized to achieve economic growth within planetary boundaries. This implies a paradigm shift regarding recent production, consumption and trade patterns. A major task was to achieve an energy system based on renewable energies. For mobile applications the post Paris regime is pushing towards fading out the use of conventionally fuelled vehicles for all transport modes, including rail.

The expected transformation has multiple consequences regarding economic and societal change. A high share of population is rapidly moving to growing metropolitan areas. Proactive labour market and social security policies have to tackle unemployment, and have to sustain social welfare and public health. Resilient economic and social structures have to be developed to address the diverse economic and social change dynamics in regions and districts across Europe. The mobility and transport demand is still growing.

The expected industrial transformation has dramatic consequences for the rail sector as backbone of the European transport system. On one hand it looks that already electrified and energy efficient railway may gain a golden opportunity to be revitalized. On the other hand the expected transformation puts a heavy burden for the rail sector, because it has to comply with its role as backbone of the European transport system. Public and private household budgets are not expected to strongly increase, so new business models are wanted, although economic revenues cannot be as simply gained as in the years before.

European rail industries and operators have to expand to comply with the role as the backbone of the European transport system. Rail operating companies are converging into door-to-door mobility providers, although this implies for them to strongly diversify their business concepts, expanding for example sample to car- and bike sharing fleet operators.

Barriers regarding rail liberalisation are still challenging due to comparative market advantages of large rail operating companies. European policy level regulatory power is expected to stay related to the coordination of the rail technical system. Most rail services are expected to remain under public service obligations (PSOs). They are seen as crucial for social cohesion and regional economic development and growth.

Rail freight transport still undergoes severe competition coming from the road sector. The road sector is expected to become electrified and (semi-)automated. However, with the post Paris climate regime, fossil fuelled vehicles have to be replaced up to 2050 and beyond. Heavy duty vehicle operation, fuelled with alternatives like 2nd generation bio-fuels or synthetic fuels (e.g., power to gas, power to liquid) or with huge battery packs, is expected to be in 2050 more expensive than highly efficient electrified rail freight service operation.

Public budgets are expected to further decrease or at least not to increase in a way which would be strategically necessary to finance the requisite infrastructure transformation. Civil society opposition against financial risks of large infrastructure spending are underlining rather reluctant public investment strategies. Public private partnerships (PPP) are in several cases a favourite option, but in other cases PPPs are not operational.

An integrated rail-road strategy is crucial to achieve the post COP21 Paris climate regime. Infrastructure capacity has to increase, but it may be still not sufficient to absorb the mobility and transport demand. Public budget constraints and public enmity against new infrastructure and high infrastructure spending leads to rely on existing infrastructure capacity. With the broad extension of electrified infrastructure for all transport modes, resource scarcity, in particular for copper and some rare metals, is expected. Costs are increasing as environmental damage in exploiting and processing these resources.

Technological progress is heading towards novel technologies, i.e. for next generation train control. Light-weight materials are adopted in railcar design. Regulatory governance is allowing more radical technological progress, in particular to improve the capacity of rail. More systems, including mainline rail lines, may, for example, become driverless.

The Regional and Suburban Rail Market Study

Then WP2 also produced an update of the work performed for the first time in 2005 is based on a survey and desk research and its objective was to get an accurate overview of the importance of regional railway in Europe. It provides a definition of Regional and Suburban Railways (RSR) and an in-depth picture of this business field based on data collected in 2014 and 2015. This study confirms the critical importance of regional and suburban railways in the EU, which account for 90% of total railway passengers and 50% of passengerkilometers. Regional and suburban trains carry as much passengers as all metros in Europe and 10 times more passengers than air travel within the EU (based on 2014 Eurostat figures).

Another less-known attribute of the RSR segment (and of rail in general) is the fact that it provides a large number of local jobs which cannot be delocalized. The RSR study has shown that there are more than 360.000 jobs in train operating companies alone, and many more that are linked with the rail sector This overall market is nearly entirely governed by Public Service Obligation contracts between governments (mainly at infra-national level) and operators. The lion's share of the service production is still in the hands of the large incumbent operators, even in countries where liberalisation is well advanced (Germany, Nordic countries, etc.). The only exceptions are UK and Poland.

This segment suffers from unbalanced competition with private car and has still a large potential for growth as leverage of sustainable land use and suburban/regional mobility policies. In addition, this study presents clear arguments as to why, instead of disregarding it or even allowing for its dismantlement, the European Union and national policy makers should provide this rail segment with the necessary investments and regulatory framework, as this is a vital source for regional and urban mobility, decongestion solutions, environmental action and economic competitiveness.



STRATEGIC RAIL RESEARCH & INNOVATION AGENDA (SRRIA)

It was the role of WP3 to update the previous ERRAC Strategic Rail Research Agenda as well as focus also explicitly on 'Innovation". Thus the SRRIA was developed.

This SRRIA specifically addresses the European efforts required for research and innovation to achieve the ambitious goal set out by the European Commission in the Transport White Paper published in 2011 where it is recognised that European Transport is at a cross roads, and that old challenges remain but new ones have come. Although transport accounts for about a quarter of all greenhouse gas (GHG) emissions, rail is responsible for significantly less than 1% of transport's total share. Almost all the emissions arise from car use, aviation and shipping, which are almost completely dependent on fossil fuels.

Transport, nevertheless, is recognised as being of key importance for both employment and economic growth. The Transport White Paper underlines the need to implement "new technologies" to ensure sustainable mobility. The European Commission is committed to a "Europe 2020" strategy based on smart, sustainable and inclusive growth but also concerned about the environmental, security, social and economic implications of current patterns of energy usage. It wants to find ways of decoupling economic growth from resource and energy use. It also wants to see a shift to a resource-efficient, low carbon economy avoiding transport pollution and congestion to grow. This calls for a massive technological improvement and a radical systemic change. Rail is seen as being a main part of the solution.

Among the ten high level goals for a competitive and resource-efficient transport system, nine imply significant development of rail infrastructure, services and technologies.

Overall transport activity is expected to grow substantially by 2050, with freight volumes increasing by more than 80% and passenger volumes by more than 50%.

Research and innovation can bring groundbreaking solutions to most of these objectives and challenges. ERRAC is involved in defining the Research and Innovation strategy of the rail sector in Europe, supporting and enhancing cooperation among European stakeholders as well as creating links with other sector stakeholders and decision-makers (at European, national and regional levels).

Building on the 2007 Strategic Rail Research Agenda (SRRA)¹ and following the publication of "RAILROUTE 2050²", this updated **Strategic Rail Research and Innovation Agenda**, a **step change in research and innovation** (SRRIA-2014) aims at orienting and guiding the research efforts of the railway sector and the decisions of policy makers and other stakeholders. Increasing the attractiveness of a high capacity, environmentally friendly and cost efficient railway in Europe will underpin economic growth and societal development.

The SRRIA sets out research and innovation priorities structured around ten themes. The first theme addresses the attractiveness of rail and public transport and the future demand that the rail sector aims to meet. The second set includes three critical themes within a sector-wide framework and finally the third set covers five well-established asset-related themes:

- 1. Attractiveness of rail and public transport Customer experience Strategy and economics
- 2. A whole system approach

Capacity, performance and competitiveness Energy and environment Safety (including certification) and security

3. Assets

Control, command, communication and signalling Infrastructure Rolling stock IT and other enabling technologies Training and education

^{1.} http://demo.oxalis.be/errac/errac_website/wp-content/ uploads/2013/06/SRRA-2007.pdf

^{2.} http://www.errac.org/wp-content/uploads/2013/11/D9-SRRA-RAILROUTE2050.pdf

TECHNOLOGY AND INNOVATION ROADMAPS, EXPLOITATION & IMPLEMENTATION

In support of European Union action to provide sustainable solutions to the current economic problems and to address the challenges of tomorrow, the ERRAC believes that **research and innovation will enable the European rail sector to retain its excellence** and increase its global competitiveness.

Rail is now a knowledge-intensive and internationally competitive sector, striving to create an optimal eco-system for innovation. It pulls together (from across the continent) excellent research institutions and a wellperforming manufacturing industry, with a strong and increasing dedication to research, development and innovation. This new **Strategic Rail Research and Innovation Agenda (SRRIA)** is well placed to guide and inspire future research and innovation over the coming decades.

The SRRIA sets out **research and innovation priorities on a thematic basis**, focusing on the attractiveness of passenger and freight rail transport, the sector-wide framework and the management of its assets.

The strategy puts the **customer first**, prioritising its needs and satisfactions. The focus is on the journey experience, including the train and station environment, comfort, access, and value for money, taking account of feedback received.

- The customer orientation is part of a wider view of the role of technology, including digitalisation, to address strategic and economic objectives for the sector, which also includes helping the supply industry to bring its products and services to market faster and more efficiently, and for the operating community to provide reliable transport of passengers and goods.
- New safety and security challenges, including from cyberattack, will be addressed without compromising the end to end journey through the whole transport network.
- To meet the ambition that the railway in Europe should make a bigger contribution to the economy and society, it shall improve its capacity, performance and competitiveness.
- The railway is already the greenest form of mass land transport. To increase its energy efficiency and further reduce its impact on the environment, contributing to efforts to counter climate change, it will seek to: further electrify rail operations, develop hybrid propulsion solutions incorporating energy storage systems to give increased operational range and flexibility and reduced dependence on diesel design lighter trains using mechatronic systems and lighter materials, develop smart grids for energy management and introduce new noise reduction technologies.
- Creating new and maintaining existing infrastructure is the largest investment – and cost – for the European railway sector. It is important that technology and innovation deliver opportunities to reduce the cost associated with infrastructure while at the same time increasing its availability and the ability to meet service demand.

The capability and comfort of rolling stock is probably the largest factor associated with the mainline customer's experience; passengers look for ease of access, comfortable and plentiful seating in a pleasant service driven environment. Freight operators require cost effective capacity, easy handling of freight on and off trains, plus fast transit between terminals. Technical innovation will target cost reduction through mass optimisation, balancing the need for vehicle strength and robustness in mass efficient manners, innovative power generation and drive systems (e.g. hydrogen powered) or on board electrical generation, semi-conductors and energy efficiency for heating, ventilation and air conditioning.

- Improving the passenger and freight endto-end journey experience requires a step change in the speed, efficiency, quality and exploitation of data and information by European railways and increased inter-modal cooperation. Central to the IT enhancement of the railway is the foreseen Connected Train – featuring data exchange for operational, engineering and customer service purposes.
- The railway requires a sustained supply of high quality, trained and skilled human resources across a range of disciplines, even as technology is changing the balance of the requirement. Measures to meet this need include the higher education offer, advanced training courses, the European Railway University and a harmonized Transport Doctorate.

These roadmaps set out a **challenging agenda** for rail research and innovation in the rail sector in the coming years and decades. Some of it is already in hand or planned though the so-called **Shift2Rail Joint Undertaking and other initiatives**. Other parts are aspirational, **yet realistic**. If the railways of Europe and their partners in industry and academia can deliver on these challenges, the **future of the sector is very bright**, with great benefit to all who use and work in the railway.

FOSTERING INNOVATION AND PARTNERSHIPS: ERRAC & SHIFT2RAIL

This Work Package heavily relied on the implementation of the proposed joint undertaking for research, development and innovation for rail (under the acronym: Shift2Rail).

This Work Package launched several activities:

- 1. One of the activities was to propose the necessary strategic and operational links between ERRAC and the Shift2Rail initiative and identify the coordination requirements. However, at the time of the Foster Rail proposal establishment, it was foreseen that Shift2Rail would have been structured in a short time, allowing ERRAC with its newly created "ERRAC Strategy Board" to match and provide direct support in the shaping of the Shift2Rail structure. However, the Shift2Rail Regulation adopted on July 2014 does not foresee the same number of committees as the ones identified initially in the Foster Rail proposal. And it provides a clear role to ERRAC directly in the operation phase rather than in the setting up phase – where the European Commission remains responsible. Nevertheless, the WP5 monitored the set-up of Shift2Rail and informed the ERRAC stakeholders. First ERRAC officially endorsed Shift2Rail on 15 November 2013. Then the ERRAC Strategy Board was informed about the progress of Shift2Rail. Two ERRAC Permanent Advisory Groups (Academia and Member States) were set up and informed about Shift2Rail status. Last but not least one single pre-requirement group was set up and integrated within the preparatory phase of Shift2Rail in order to try to boost the inputs from the interested parties.
- 2. A second activity was to provide the framework under which the creation of "system pre-requirements groups" for each Shift2Rail Innovation Programme can be established and to seek to ascertain the business-led needs of the wider rail sector in order to identify the core requirements that each of the Innovation Programmes will be required to develop. Furthermore, it group will support the move towards creation of a single European rail area.
- A third activity was to support the knowledge widening of partnership of the Shift2Rail initiative.
- 4. A further activity was to create a database for potential partners to the Shift2Rail Innovation Packages and to support the identification of possible new Shift2Rail Associated members.
- Finally WP5 set out to make a comparison between the FOSTER RAIL SRRIA and the Shift2Rail Multi Annual Action Plan – MAAP – in order to advise the European Commission which important areas should be covered better within the future Work Programmes for EC funded research.

MONITORING TO IMPROVE RAIL RESEARCH INNOVATION

An important part of the FOSTER-RAIL project is the monitoring of rail research activity. Previously, the rail sector did not know the market impact of previous research well enough and a great deal of research funding has been wasted on research that has had no demonstrable impact.

In order to improve the situation, an evaluation methodology based on the previous analysis of project results and deliverables has been used, together with a set of interviews of project participants and other stakeholders, aimed at determining the actual implementation and market uptake of the project results by the rail sector once the work has ended. Once an evaluation is done, the impact is visible and the results can be used by follow-on projects and taken into account in future research. The recording and analysis of past research also helps to improve the effectiveness of the ERRAC FOSTER-RAIL roadmaps by preventing duplication of previous research and identifying the gaps in future research.

As a result of the evaluation related to the key questions, the market uptake is determined and the presentation is completed in the final slides with the evaluation's conclusions, in particular focussing on the *Reasons for Outcome and Lessons Learnt.*

The evaluation activity in FOSTER-RAIL project builds on the previous work of the ERRAC-ROADMAP project's Evaluation Working Group, continuing and developing its tasks. The development and administration of **ERRAC rail research database** is another important activity within WP6, essential to support the evaluation of past research and achieve its main objectives.

WP6 has undertaken 34 project evaluations and completed over 20 evaluations. The completed evaluations have added to the previous EWG evaluations, meaning that over 80 projects have been evaluated by ERRAC since 2006.

Meantime, considering the lessons learnt from previous project evaluations, the FOSTER-RAIL project has monitored relevant ongoing projects and developed significant case studies. The **monitoring methodology** is based on the analysis of relevant ongoing rail research projects with respect to foreseen implementation and exploitation of results, according to initial objectives and contracted research work. A questionnaire was developed to facilitate the discussions with the project coordinators and better clarify all aspects relating to implementation and market uptake.

The project has also developed guidelines to provide European rail stakeholders involved in research and innovation activities at National and European level, with the information needed to ensure strong market uptake of their projects. This work has already resulted in improvement in the impact of the more recently evaluated European research projects.

The documentation is publicly available - The detailed reports can be downloaded from the <u>www.errac.org/Fosterrail</u> website.

The FOSTER-RAIL Partners Ansaldo STS austriatech Mobility **EURNEX** Networks CER Logistics The Voice of European Railways NetworkRail FUNDACIÓN DE LOS FERROCARRILES MELLE BLOOD **ESPAÑOLES** Transports newrail TRAFIKVERKET SWEDISH TRANSPORT ADMINISTRATION ТМВ Metropolitans de Barcelona EUROPE

More information on the project and its detailed deliverables:

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