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EXECUTIVE SUMMARY

The purpose of SETRIS is to deliver a cohesive and coordinated approach to research and innovation strategies for all transport modes in Europe. SETRIS vision is to identify synergies between the transport sector European Technology Platforms' (ETPs) strategic and research and innovation agendas (SRIAs) and between these and relevant national platforms. ETPs are industry-led stakeholder forums, recognised by the European Commission as key actors in driving innovation, knowledge transfer and European competitiveness.

The five transport sector ETPs, in alphabetical order, are:

1. Advisory Council for Aviation Research Innovation in Europe (ACARE);
2. Alliance for Logistics Innovation through Collaboration in Europe (ALICE);
3. The European Rail Research Advisory Council (ERRAC);
4. European Road Transport Research Advisory Council (ERTRAC);
5. Waterborne;

The FP7 Coordination and Support Action, FOSTER RAIL, addressed the key challenges of railways researches of strengthening research and innovation in the railway sector and build a strategy for the European rail research up to 2050. SETRIS offers the opportunity for ERRAC to foster the implementation of the priorities defined in FOSTER RAIL and take a step further by collaborating with other transport ETPs to build the future integrated transport system.

This deliverable D3.8 aims at identifying the synergies between the relevant national and EU programmes – including Shift2Rail - which could support the implementation of ERRAC priorities. Emphasis is put on:

- How these priorities are aligned with ERRAC priorities;
- How they could support the implementation of ERRAC priorities in a coordinated manner with ERRAC and EU Institutions.

Based on the analysis of the railway research priorities of national governments and EU programs, ERRAC provides the following recommendations:

- **Encourage research initiatives that will enable the implementation of ERRAC:** Shift2Rail addresses many of the technological challenges that needs to be tackle by the railway sector, but not all, thus to ensure the competitiveness and the adaption of the railway transport mode to society needs and changes, it is necessary to implement all areas of research defined in ERRAC roadmaps. Rail research initiatives should not only be limited to rail, consider related societal aspects and include cross cutting fields such as human and organizational factors, public health, spatial strategy, energy and environment. In addition, urban transport at city level, not only as a mode to fulfill the first and last miles of a journey, should be considered. Rail urban travels may start and finish in the same city. However, they should be considered as part of the S2R ecosystem, as there is more than a mean to complete long-distance travels. In 2050 more than 60% of the European population will be urban so will be the main part of the journeys.
- **Maintain and develop relation with NTPs and national initiatives by taking in account regional disparities:** as this report shows, the priorities of national master plans are in most case aligned with ERRAC priorities. But in term of implementation of rail research initiatives, not every country in the study had a research program dedicated to railway research. It is therefore important that ERRAC develops and maintains its relations with NTPs and national

government but also takes in consideration the disparities in Europe and adapts, in accordance, its strategy for the promotion of railway research and knowledge.

- **Raise awareness about the digital revolution and new paradigms that could be developed from enabling technologies:** as the study shows digital technologies are not always identified as main priorities in the majority of transport/railway master plan. It is the role of ERRAC to promote enabling technologies in the European railway sector. Regional disparities should of course be taken in account and emphasis should be put on technologies with high return of investment.
- **Enhance collaboration with transport ETPs to support the achievement of the integrated transport system:** ETPs should work together and in a coordinated manner in order to make the integrated transport system a reality. In this prospect, ERRAC members will actively work on their participation in H2020 research and innovation activities related to intermodal transport. The role of ERRAC in this collaboration is also to incentivize that rail is a privileged backbone of the future integrated transport system in Europe and ensure that financial investments are distributed accordingly.
- **Further develop relations with the ECTP to tackle the challenges of the future railway infrastructure:** despite the growing demand for railway infrastructure, driven by rapid urbanization, road congestion and societal demands for a green mobility, railway infrastructure assets are aging and need to be modernized in many areas. A high level of investment is especially required for mainline infrastructure. Railway infrastructure is a key item for the European transport system, the collaboration between ERRAC and the ECTP is necessary to exhaustively address the challenges of the future infrastructure (including maintenance).
- **Investigate the possibility of further exchanges with CEF transport:** lessons learnt and data from CEF transport projects would significantly enrich the state of the art in fields related to railway infrastructure and research and innovation bodies could improve this knowledge with new enabling technologies, optimized implementation methods and guidelines. There should be dedicated CEF funding made available to foster automation and digitalization of the railway sector. CEF eligibility should also be extended to rail rolling stock in order to support the decarbonisation of the rail systems. It will be also important to increase support to the urban nodes located on the TEN-T Core Network, and to provide adequate grants support for sustainable transport infrastructure and rolling stock projects. Virtually all passenger journeys start or finish in urban areas; therefore, the quality and efficiency of urban public transport infrastructure, interchanges and services must be ensured.

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ACRONYMS AND ABBREVIATIONS

ACARE:	Advisory Council for Aviation Research and Innovation in Europe. Air ETP (http://www.acare4europe.com/)
ALICE:	Alliance for Logistics Innovation through Collaboration in Europe. Logistics ETP. (http://www.etp-alice.eu)
CBTC:	Communications-Based Train Control
CCA:	Cross-cutting Activities
CEF:	Connecting Europe Facility (https://ec.europa.eu/inea/en/connecting-europe-facility)
CZTP:	Czech National Technology Platform for the Interoperability of Railways Infrastructure
EC:	European Commission
ECTP:	European Construction Technology Platform (http://www.ectp.org/)
ERRAC:	European Rail Research Advisory Council. Rail ETP. (http://www.errac.org/)
ERTMS	European Rail Traffic Management System
ERTRAC:	European Road Transport Research Advisory Council. Road ETP (http://www.ertrac.org/)
ETCS:	European Train Control System
ETPs:	European Technology Platforms
EU:	European Union
FOSTER RAIL:	Future Of Surface Transport Research Rail (http://www.errac.org/foster-rail/)
FP:	Framework Programme
FTI:	Fast Track to Innovation
GNI:	Gross National Income
H2020:	Horizon 2020 (https://ec.europa.eu/programmes/horizon2020/)
HVAC:	Heating, Ventilation and Air-Conditioning
ICT:	Information and Communications Technology
IP:	Innovation Programme (linked to Shift2Rail)
IT:	Information technologies
ITS:	Intelligent Transport system
JU:	Joint Undertaking
LatDEA:	Latvian Transport Development and Education Association (http://www.latdea.lv/)
MAAP:	Multi-Annual Action Plan (linked to Shift2Rail)
NTP:	Plataforma Ferroviária Portuguesa (see also PFP, Portuguese Railways Platform)
NTPs:	National Technology Platforms

PFP:	Portuguese Railways Platform
REFINET:	REthinking Future Infrastructure NETworks (http://www.refinet.eu/)
R&I:	Research and Innovation
RIA:	Research and Innovation Actions
RTDI:	Research, Technological Development and Innovation
RSSB:	Rail Safety and Standards Board
S2R:	Shift2Rail
SME:	Small and Medium Enterprise
SRIA:	Strategic and Research and Innovation Agendas
SRRIA:	Strategic Rail Research and Innovation Agenda
TDFs:	Technological Demonstrators
TMS:	Traffic Management Systems
UK:	United-Kingdom

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1. INTRODUCTION

The purpose of SETRIS is to deliver a cohesive and coordinated approach to research and innovation strategies for all transport modes in Europe. SETRIS vision is to identify synergies between the transport sector European Technology Platforms' (ETPs) strategic and research and innovation agendas (SRIAs) and between these and relevant national platforms. ETPs are industry-led stakeholder forums, recognised by the European Commission as key actors in driving innovation, knowledge transfer and European competitiveness.

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The FP7 Coordination and Support Action, FOSTER RAIL¹, addressed the key challenges of railways researches of strengthening research and innovation in the railway sector and build a strategy for the European rail research up to 2050. SETRIS offers the opportunity for ERRAC to foster the implementation of the priorities defined in FOSTER RAIL and take a step further by collaborating with other transport ETPs to build the future integrated transport system.

This deliverable D3.8 aims at identifying the synergies between the relevant national and EU programmes – including Shift2Rail - which could support the implementation of ERRAC priorities. Emphasis is put on:

- How these priorities are aligned with ERRAC priorities
- How they could support the implementation of ERRAC priorities in a coordinated manner with ERRAC and EU Institutions.

In order to reach this aim, this document builds upon the outcomes of FOSTER RAIL, especially deliverables *D1.4 Developing links and coordination strategies between ERRAC, EU and national technology platforms. Recommendations for the future* (FOSTER RAIL D1.4, 2016) and *D4.9 Final Technology and Innovation Roadmaps* (FOSTER RAIL D4.9, 2016), and goes beyond by identifying the synergies between EU and national programmes and ERRAC priorities to foster their implementation.

¹ http://cordis.europa.eu/project/rcn/110534_en.html

2. ERRAC TECHNOLOGY ROADMAPS

The project FOSTER RAIL provided a relevant *Strategic Rail Research and Innovation Agenda* (FOSTER RAIL D3.2, 2015; onwards SRRIA) as well as for 2050. Following the structure of this new SRRIA, 10 new thematic focused roadmaps have been developed, based on the previous 9 ERRAC roadmaps from 2012 established by the FP7 ERRAC-Roadmap² project. ERRAC priorities were updated in FOSTER RAIL with the development of the SRRIA, the *FOSTER RAIL Rail Business Scenario* (FOSTER RAIL D2.6, 2015). The SRRIA priority areas covered by these 10 roadmaps are the following:

- Customer experience
- Strategy and economics
- Capacity, performance and competitiveness
- Energy and environment
- Safety (including certification) and security
- Control, command and communication
- Infrastructure
- Rolling stock
- IT and other enabling technologies
- Training and education

These roadmaps are fully described in the FOSTER RAIL deliverable: *D4.9 Final Technology and Innovation Roadmaps*.

3. METHODOLOGY

In the FOSTER RAIL deliverable *D1.4 Developing links and coordination strategies between ERRAC, EU and national technology platform. Recommendations for the future* (FOSTER RAIL D1.4, 2016), a questionnaire was sent to National Technology Platforms (NTPs) in order to collect their views on ERRAC priorities. In this document, the focus is more on the actual policies and research initiatives and strategies which have been undertaken for railways and their alignment with ERRAC priorities.

Figure 1 summarises the methodology used to fulfil the objectives of this deliverable:

² http://cordis.europa.eu/project/rcn/92969_en.html

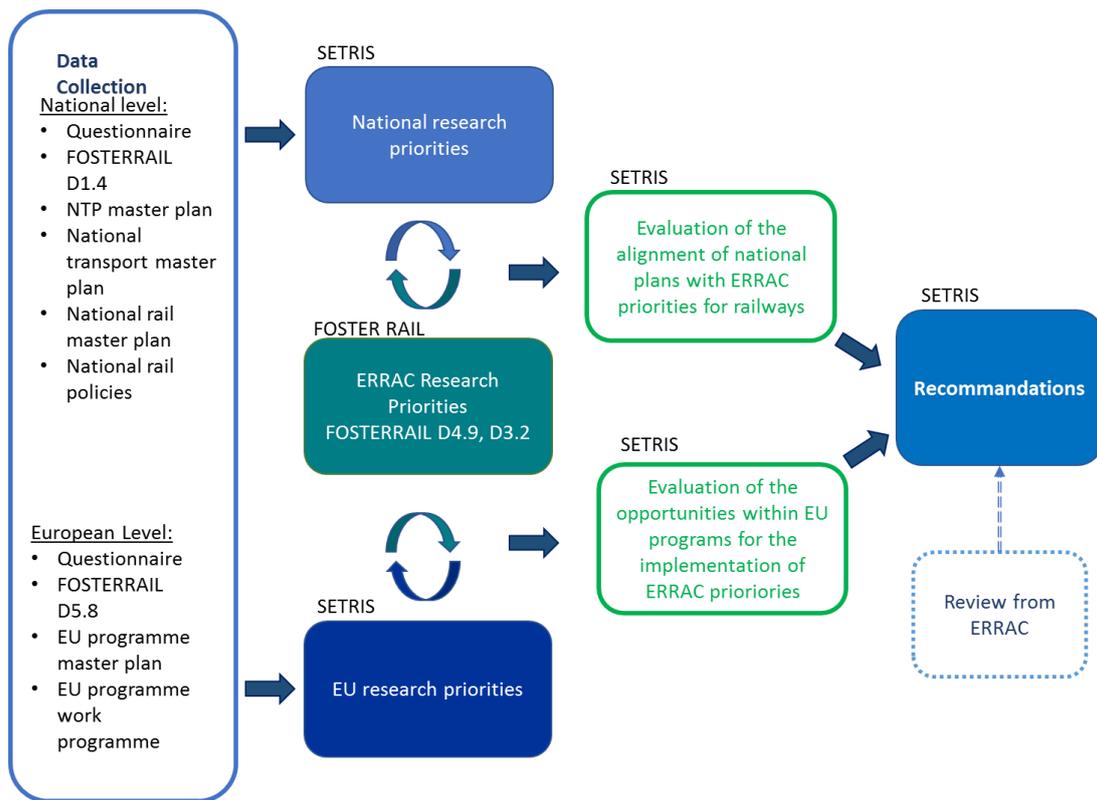


Figure 1. Methodology of D3.8
Source: SETRIS

In the course of the SETRIS project, the questionnaire detailed in appendix A, has been sent to the transport National Contact Points in order to collect national research strategies for railways. The purpose of this questionnaire is to picture the national research priorities align with ERRAC objectives throughout Europe. Answers to the questionnaire have been received from Austria, Latvia, United Kingdom, Romania, Spain and Norway (associate country). Taking in consideration specific rail-related national policy reports as well as the 8 NTPs identified in the FOSTER RAIL deliverable: *D1.4 Developing links and coordination strategies between ERRAC, EU and national technology platforms. Recommendations for the future* (FOSTER RAIL D1.4, 2016), national research priorities have been collected in 8 EU member countries (Austria, Czech Republic, Latvia, Poland, Portugal, Romania, Spain, United-Kingdom) and 1 associate country (Norway). The collected national research priorities have been compared with ERRAC priorities and similarities and gaps have been analysed.

In parallel to this work, the priorities and master plans of on-going EU funding programs have been investigated and a set of opportunities to support the implementation of ERRAC priorities have been identified.

Regarding these two tasks, the Section 6 of this document provides a collection of recommendations to enhance collaboration between ERRAC and national and European programs and to aim for an efficient implementation of the ERRAC roadmaps. These recommendations have been validated through a questionnaire sent out to the ERRAC community. The results of the 14 answers received from ERRAC community members are detailed in appendix B.

4. National research priorities

4.1 Overview of National priorities for railways

4.1.1 Austria

The approach of Austria for national transport related research is systemic and not distinguished by transport mode. Therefore, rail research priorities in Austria are aligned with the following transport research priorities defined by the Austrian program “Future Mobility”³ (Future Mobility, 2012):

Mobility of Goods:

- Sustainable Transport Chains
- Sustainable Mobility of Goods in Cities
- Sustainable Last Mile and First Mile Solutions
- Intermodal transport hubs
- Innovative means of transport

Personal Mobility:

- Accessibility for all
- Information, navigation and way finding
- Innovative means of transport
- Tools for demand survey and transportation planning
- Awareness building and shaping behaviour

Transport Infrastructure:

- Effective asset management
- Energy Efficiency
- Innovative road way and track systems
- ITS for transport infrastructure
- Safety in transport infrastructure
- Design and management
- Construction methods for transport infrastructure

Vehicle Technologies:

- Electric propulsion systems
- Lightweight vehicles

The Research Program “Future Mobility” focuses on the search for integrated solutions designed to help build the mobility system of the future, a system that must balance social, environmental and economic needs. This integrated approach helps create systems that contribute significantly to ensuring mobility while minimizing the negative impacts of transport. The complex interactions inherent in transport systems require interdisciplinary research approaches aimed at developing both technological and social-organizational innovations. Thus, the program focuses on new markets, generating solutions that respond closely to the essential needs of society.

³ <https://www.bmvit.gv.at/en/innovation/mobility/index.html>

4.1.2 Czech Republic

The Czech National Technology Platform for the Interoperability of Railways Infrastructure (CZTP) is an association of 22 Czech rail sector partners created in 2008. It has for main purpose to participate in the investment production and maintenance of the railway infrastructure in the Czech Republic. The CZTP aims to prepare the required conditions for the integration of the European railway industry and the creation of a single market for its products which is aligned with the European Commission (onwards EC) Regulations on the interoperability of trans-European high-speed and conventional railway system. These requirements must be applied in construction, related-production and maintenance.

One of means for the achievement of the interoperability is the division of the European railway system into sub-systems:

- Infrastructure (rails, switches, constructions),
- Energy (electrification equipment, overhead trolley lines),
- Control, command and signalling (equipment for ensuring the safety, control and regulation of the movement of trains),
- Interface (current collectors, wheel-rail interface, etc.)

Regarding national priorities the *Policy Statement of The Government of The Czech Republic (Czech Republic, 2014)*⁴ stated the following policies concerning the railway sector:

- Ensure cost effective and high-quality transportation as a basic public service for citizens, advancing hand in hand with regional development;
- Achieve the completion of the third and fourth rail corridor and modernisation of important railway junctions, but shall also accelerate the preparation and implementation of the necessary bypasses, eliminate black spots and revitalise critical national and regional railways. Quality transport infrastructure is a prerequisite not only for the regional development and economic growth of the state, but also for the mobility of citizens and their jobs;
- Increase resources for the repair and maintenance of transport infrastructure in order to bring an end to the long-term underfunding which degrades these networks;
- Support the development of integrated transport systems, and ensure their interconnectivity and coordination in the Czech Republic;
- Foster conditions necessary for effective, non-discriminatory market liberalisation (e.g. harmonised tickets, revenue clearing, information systems or access to service facilities);
- Strengthen the role and appeal of rail transport in the Czech transport system, and reinforce the function of Czech Railways (as a national carrier providing access to public passenger transport) and ČD Cargo, a.s. (as a major freight carrier providing comprehensive services throughout the Czech Republic).

⁴ https://www.vlada.cz/assets/media-centrum/dulezite-dokumenty/en_programove-prohlaseni-komplet.pdf

4.1.3 Latvia

Most of the transport research activities in Latvia are carried out by technical universities such as the Riga Technical University and the Transport Telecommunication Institute, into which the Ministry of Education and Science is currently integrating specialised state research institutes. The Latvian Transport Development and Education Association (LatDEA), a non-government organization, also plays a pivotal co-ordination role. LatDEA's main objective is to support the modernisation of Latvia's transport sector, by increasing its research potential and by improving the quality of its academic and training institutions.

At short-medium term, the main challenges to be solved in the railway sector are the refurbishment and modernisation of infrastructure, increase of safety levels and increase of throughput capacity. In public transport, especially in the railway sector, it is necessary to resolve issues concerning modernisation of rolling stock and establishment of an appropriate infrastructure. Research in the sector is driven by these problems and oriented to find necessary solutions.

The long-term objective of Latvian transport policy is to ensure the systematic maintenance and development of an effective, sustainable, integrated, environmentally friendly, balanced and multimodal transport system that will meet the increasing demands of the national economy, international trade and of the population for a qualitative and quantitative transport service ensuring safety, reliability and reasonable prices.

4.1.4 Poland

The Polish Ministry for Infrastructure and Development has published in 2013 a *Report on the implementation of the Polish transport development strategy to 2020*⁵ (Poland, 2013). The main objective is to increase the availability of the transport while improving the safety and efficiency of the transport sector itself. It is to be achieved by creating a coherent, sustainable and user-friendly transport system. The challenge of creating an integrated transport system in Poland by 2020 will be to catch up on the expansion and modernization of the transport infrastructure.

The report identified gaps to be bridged for the railway sector by 2020 such as:

- Improve competitiveness of the railway freight
- Adapt of railway track systems to anticipated transport needs
- Develop modern railway traffic control devices
- Increase capacity and ensure punctuality
- Improve the management of intermodal terminals

4.1.5 Portugal

The Portuguese NTP – Plataforma Ferroviária Portuguesa (PFP, Portuguese Railways Platform) have been officially launched on 9th July 2015 and therefore the strategy for railway research was still not established during the project lifetime of FOSTER RAIL. However for the time the SETRIS project is on-going more information was available. The strategic agenda of PFP for research and innovation is composed of 8 innovation projects (PFP, 2015):

P1 Rolling Stock

⁵ https://www.mr.gov.pl/media/3372/Strategia_PW_11_07_2013_zmn.pdf

- To identify target rolling stock;
- To design and development of new solutions;
- To implement pilot projects by series of target rolling stock;
- To reach out the various projects to target fleets of rolling stock;
- To homologate the solutions;
- To commission the various solutions that were developed;
- To endurance the solutions;
- To promote solutions developed on both local and international markets.

P2 Attractiveness

- To identify the information and safety requirements;
- To take stock of existing systems;
- To develop info-entertainment systems and passive monitoring systems;
- To apply the technological achievements of this project to a number of subprojects including the “Implementation Survey on the Sintra and Cascaiss Commuter Lines and suburban lines in Porto in articulation with other mobility systems”.

P3 – Command, Control and Communications

- To review new methods of active protection of both vehicles and travellers;
- To develop solutions for safe and efficient data transmission and geotracking;
- To develop new traffic control display platforms;
- To develop new support systems for train drivers;
- To develop ERTMS systems or other Open ETCS compatible systems.

P4 – Infrastructure

- To develop remote monitoring solutions for rail assets, including software apps for mobile devices;
- To develop support systems to assist in decision-making relating to renewal and maintenance based on degradation models;
- To develop new structural solutions by resorting to new materials with a view to cut life cycle born costs;
- To carry out an integrated review of investments in transport infrastructure.

P5 – Energy Efficiency

- To develop smart grid solutions;
- To develop algorithms to determine the times and the optimum acceleration and braking curves (Eco driving);
- To develop algorithms to determine and share traction power costs and consumption;
- To develop methodologies to optimise energy in rolling stock material;
- To review power storage methods as a way to optimise consumption.

P6- Freight

- To identify improvements in train station layouts;

- To develop technologies that lower formation, marshalling, loading and unloading times of trains in terminals;
- To identify constraints, to review and put forward solutions, for instance as to towed freight in given routes, the length of train units in stations and operation in terminals and optimising communications.

P7- Interoperability and Homologation

- To review the process to speed up rail certification and authorisation within a European legal frame;
- To survey trends and methodologies for the authorisation of track vehicles;
- To review the authorisation procedures (players, traineeships, interfaces, methodologies national regulations);
- To review the economic incentives (for instance as to integrating the ERTMS on board the vehicles).

P8 – Knowledge Management

- To develop and launch a knowledge management platform;
- To develop and adapt the syllabus for master degrees and PhD levels;
- To assist in developing advanced training diplomas in the railway issues;
- To conduct training in emerging technologies;
- To set up an observatory for the sciences and technologies with an impact on the rail sector.

4.1.6 Romania

In Romania, there is no dedicated transport research and innovation policy. Rail projects are usually funded under the Romanian environment or engineering programs, but due to the lack of funding, this does not occur frequently.

The focus in Romania is the modernization and development of the infrastructure. There are two main pillars of investment described within *Romania's Transport Master Plan* (Romania, 2015) concerning railways. First of all, 9 bln. Euros until 2035 for the modernization of approximately 2700 km of railway lines. Secondly, the electrification of 450 km of rail lines for approximately 1.1 bln Euros until 2025. There are other additional smaller modernisation projects specifically for industrially relevant lines and touristy lines.

However, despite this investment in the development of rail infrastructure, the lack of budget for high speed line could in the future leads to bigger gaps in terms of attractiveness of the railways when compared to other transport modes.

4.1.7 Spain

In Spain, the Ministry of Public Works and Transport is responsible for preparing and implementing government policy on transport. The *Spanish Infrastructure, Transport and Housing Plan* for 2012-2024 (Spain, 2012) is the Ministry of Public Works and Transport's reference framework for medium- and long-term strategic planning with regard to infrastructure, transport and housing in Spain. Regarding transports, the plan provides an integrated vision structured more around broad directives than

around measures devoted to modes. Focusing on passengers and goods, the plan places emphasis on the quality of service provided to users.

In addition, a *Transport and Infrastructures Innovation Plan* is currently being prepared. The first version is expected to be available by the end of 2017.

Moreover when addressing in particular the research, development and innovation activities, the scope of the transport research activities in Spain is determined by the government strategy for research and innovation, and various policy documents that provide the framework for the transport system and policy development. Legislation on Science, Technology and Innovation passed in May 2011 introduces significant changes to the organisation of the research system. The *Spanish Strategy of Science, Technology and Innovation*⁶ (Spain, 2013) is the framework instrument that establishes the general objectives linked to fostering and developing RTDI activities in Spain during 2013-2020. These objectives are aligned with the ones highlighted by the European Union under Horizon 2020. Therefore they contribute to promote the participation of the Spanish System of Science, Technology and Innovation stakeholders into the European Research Area.

The national rail research priorities are defined by the Spanish Railway Sector through the Spanish Railways Technological Platform (PTFE) and reflected in the document *Strategic Research Agenda for the Railway Sector* (PTFE, 2017). It was elaborated for first time in 2008 and since then is continuously updated, with follow-up documents dated in 2011, 2013, 2017.

The Spanish Rail Research Priorities are organized around the following areas:

1. Policy, planning, economics and energy and sustainability
2. Interoperability and ERTMS
3. Rolling Stock
4. Platform, superstructure, track and facilities
5. Railway system operation
6. Rail freight transport

4.1.8 United-Kingdom

For decades, transport investment has not kept pace with demand in United-Kingdom. That is why the government of United-Kingdom (onwards UK) increases the level of investment in transport by 50% up to 2020. The aim of this investment is not only to deliver new and highly efficient infrastructure, but also has positive social and economic impacts on the United-Kingdom. Major projects like High Speed 2⁷ and Crossrail⁸ create some of the largest value contracts in the UK construction history. The British Transport infrastructure skills strategy⁹ sets out how we will grow the skills needed across all transport industries.

But Government investment will not solve all problems. There is also a need to increase private investment. This means being an attractive destination for inward investment. It also means getting the regulatory framework right for all the businesses that use the transport networks. The UK government is committed to providing a regulatory environment which helps businesses to take

⁶http://www.idi.mineco.gob.es/stfls/MICINN/Investigacion/FICHEROS/Spanish_Strategy_Science_Technology.pdf

⁷ <https://www.gov.uk/government/organisations/high-speed-two-limited>

⁸ <http://www.crossrail.co.uk/>

advantage of new opportunities and incentivises when addressing the development of innovative technology.

Regarding transport policy, there is, in the UK, a *Single Departmental Plan for transport* (United Kingdom, 2016). The objectives are:

1. Boosting economic growth and opportunity
2. Building a One Nation Britain
3. Improving journeys
4. Safe, secure and sustainable transport

The Rail Safety and Standards Board (RSSB) developed the *Rail Technical Strategy* (RSSB, 2012), aimed at helping to achieve the industry and government's long-term goals for the railway. The Rail Technical Strategy of RSSB identified 6 major themes to support the transformation of railways in the United-Kingdom:

- Control, command and communication
- Energy;
- Infrastructure;
- Rolling stock;
- Information;
- Customer experience.

4.1.9 Norway (associate country)

The long-term objective in Norway is to achieve a transport system that is safe and secure, that promotes value creation and that contributes to the creation of a low emission society.

The 3 main objectives regarding transport policy in Norway are:

- Better accessibility of people and goods in all of Norway;
- Reduced number of traffic accidents according to the 'zero vision';
- Reduced greenhouse gas emissions and reduction of other negative environmental consequences.

In addition, there are many relevant policy fields that are not directly (or only) related to transport, such as accessibility for all and increased exploitation of existing infrastructure that are applicable across all transport modes.

Concerning the railway transport mode, the goal is to advance toward:

- a long-term strategy to further develop the railway's comparative advantages;
- a transfer of goods from road to railway to increase capacity of existing roads;
- an increased safety;
- a decreased environmental impact, and reduced greenhouse gas emissions from the transport sector.

In term of railway research, the focus in Norway is on

- Technology development for alternative energy sources, especially for non-electrified tracks (e.g. hydrogen);
- ERTMS implementation.

The aim of the railway strategy is also to ensure that the railways can be the attractive and high-capacity backbone to public transport. The railways are also an essential element to ensure that growth in urban transport is covered by public transport, cycling and walking.

4.2 Analysis

In the section 4, national research, transport and rail national strategies and research initiatives have been scrutinized for 8 EU member countries (Austria, Czech Republic, Latvia, Poland, Portugal, Romania, Spain, United-Kingdom) and 1 associate country (Norway). If the main strategy for rail policy and research does not include a theme of the ERRAC SRRIA, it does not mean that this topic is overlooked and not approached in any ways, but if one of the 10 themes of ERRAC priorities is addressed in the global transport strategy of a country, this clearly indicates implication and a strong will to tackle this challenge.

The objective of this study is therefore to evaluate for these 9 countries the level of engagement to the major railway topics set up in the SRRIA and developed in the ERRAC technology roadmaps.

The bar chart below shows for each topic of the SRRIA, the number of countries including this topic at the level of their global strategy for transport and rail.

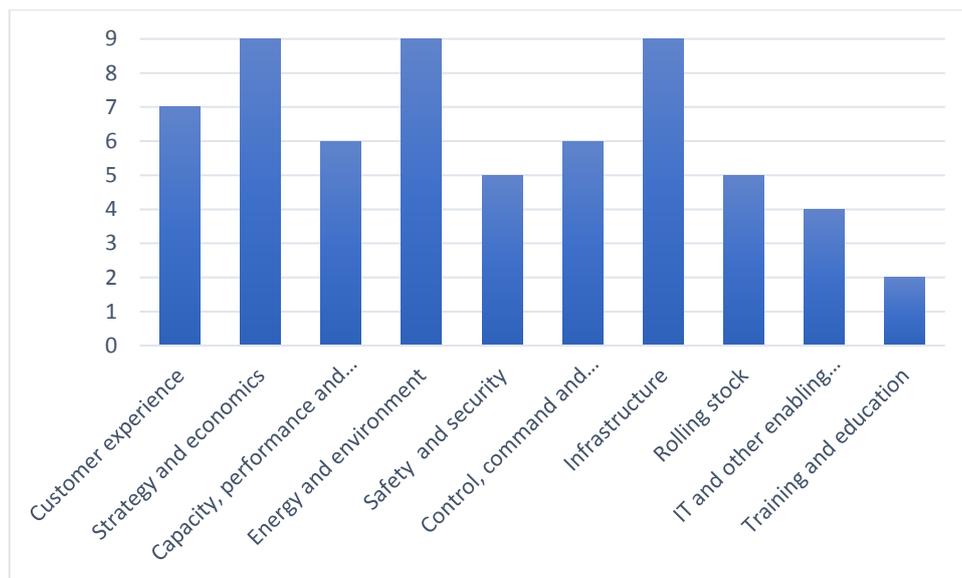


Figure 2: Alignment of the main strategies of the 9 studied countries with ERRAC priorities

Source: SETRIS project

Overall, 6 topics of the ERRAC roadmaps out of 10 are incorporated in the global rail or transport strategy of more than 2/3 of the studied countries (customer experience, strategy and economics, capacity, performance and competitiveness, energy and environment, control, command and communication, infrastructure) and more 1/2 of the studied countries incorporated 7 topics out of 10 (previous topics and rolling stock, safety and security).

On the other hand, (1) IT topics and other enabling technologies and (2) training and education are set as main priorities in 1/3 or less of the countries. However, these topics are not directly related to transport or railways, therefore it is not so unnatural that these topics are not referred at the level of global rail or transport strategies. However, the importance of these topics should not be overlooked and awareness may need to be raised further for them, especially regarding digital technologies in the eastern countries.

It is worth to note that all countries have elaborated a strategic plan for transport and, in most cases, a specified plan for the railway transport mode. The challenge regarding energy, sustainability and climate change is also addressed by all transport strategic plans of all countries. As for exclusive rail topics, infrastructure is included in all strategic plans. Railways infrastructures of western European countries are aging and require more maintenance, and infrastructures of eastern European countries need to be modernized and developed. This is therefore an issue that needs to be tackled across Europe. Actually, most of eastern countries prioritize modernisation and infrastructure development over research and innovation. For instance, Romania has no research program specifically dedicated to railways as they lack budget and really need to focus on the development and modernisation of their infrastructure. Thus, it is important for the eastern countries to efficiently implement their modernisation and development program for infrastructure taking in account technological, environmental and financial aspects. Taking this issue in consideration, ERRAC has worked closely with European Construction Technology Platform (ECTP) in the course of the project REFINET and proposed to include a case study about the Romanian railway infrastructure in the REFINET deliverable *D4.1 REFINET Strategy for the Deployment of the SIP* (REFINET, 2016). Based on this, collaboration could be further developed in the future with the ECTP.

5. EU PROGRAMME RESEARCH PRIORITIES

5.1 Overview of European programmes relevant to ERRAC priorities

5.1.1 Shift2Rail Joint Undertaking

The Shift2Rail Joint Undertaking (S2R JU) was created as a public-private partnership in the rail sector, providing a platform for the railway sector with the view to driving innovation in the years to come. Total contributions to the Shift2Rail initiative is EUR 920 million for the duration of the S2R JU. This includes the Union financial contribution and the contributions of the founding and associated members. The objective of the S2R JU is to implement a programme of research and innovation activities in the railway sector in Europe. Those activities are carried out through collaboration between stakeholders in the entire railway value chain, also outside the traditional rail sector, including SMEs, research and technology centres and universities. The S2R JU has developed a strategic Master Plan, which identifies the major objectives of Shift2Rail. Based on those objectives, the Master Plan identifies the main innovation areas that will be required to achieve the overall objectives of the JU. These are structured around five asset-specific Innovation Programmes (IPs) and five cross-cutting activities (CCA), which are further elaborated in the S2R Multi-Annual Action Plan (S2R MAAP) (SHIFT2RAIL, 2015):

- Innovation Programme 1 (IP1): Cost-efficient and reliable trains
- Innovation Programme 2 (IP2): Advanced traffic management and control systems
- Innovation Programme 3 (IP3): Cost Efficient and Reliable High Capacity Infrastructure
- Innovation Programme 4 (IP4): IT Solutions for attractive railway services
- Innovation Programme 5 (IP5): Technologies for sustainable and attractive European rail freight
- Cross-cutting activities (CCA)

Demonstration activities are a priority within Shift2Rail, as they enable the entire rail sector to visualise and concretely test the transformations that they are able to bring about. Demonstrations also enable a more appropriate quantification of the impact of each new technology (either alone or combined

with other innovations). Demonstration activities also help provide a first estimate of the anticipated potential for sector improvement (at regional, national and EU transport network levels) as a result of the developed innovations.

Technological Demonstrators (TDs) focus on the development or adoption of innovative technologies and models within the rail subsystems identified in the IPs. They will pave the way for ground-breaking progress in key research areas. The Shift2Rail TDs are listed in the S2R MAAP as follows:

IP1 – COST EFFICIENT AND RELIABLE TRAINS

- TD1.1 Traction Systems demonstrator
- TD1.2 Train Control and Monitoring System Demonstrator
- TD1.3 Carbody Shell Demonstrator
- TD1.4 Running Gear Demonstrator
- TD1.5 Brake Systems Demonstrator
- TD1.6: Doors and Access Systems Demonstrator
- TD1.7: Train Modularity In Use (TMIU)

IP2 – ADVANCED TRAFFIC MANAGEMENT AND CONTROL SYSTEMS

- TD2.1: Adaptable communications for all railways (quality of service, interfaces to signalling)
- TD2.2: Railway network capacity increase
- TD2.3 Moving Block
- TD2.4: Fail-Safe Train Positioning (including satellite technology)
- TD2.5: On-board Train Integrity
- TD2.6: Zero on-site testing (control command in lab demonstrators)
- TD2.7: Formal methods and standardisation for smart signalling systems
- TD2.8: Virtually – Coupled Train Sets
- TD2.9: Traffic management evolution
- TD2.10: Smart radio-connected all-in-all wayside objects
- TD2.11: Cyber Security

IP3 – COST EFFICIENT AND RELIABLE INFRASTRUCTURE

- TD3.1 Enhanced Switch & Crossing System Demonstrator
- TD3.2 Next Generation Switch & Crossing System Demonstrator
- TD3.3 Optimised Track System
- TD3.4 Next Generation Track System
- TD3.5 Proactive Bridge and Tunnel Assessment, Repair and Upgrade Demonstrator
- TD3.6: Dynamic Railway Information Management System
- TD3.7: Railway Integrated Measuring and Monitoring System Demonstrator
- TD3.8: Intelligent Asset Management Strategies Demonstrator
- TD3.9: Smart Power Supply Demonstrator
- TD3.10: Smart Metering for Railway Distributed Energy Resource Management System Demonstrator
- TD3.11: Future Stations Demonstrator

IP4 – IT SOLUTIONS FOR ATTRACTIVE RAILWAY SERVICES

- TD4.1 Interoperability Framework
- TD4.2 Travel Shopping
- TD4.3 Booking & Ticketing

- TD4.4 Trip Tracker
- TD4.5 – Travel Companion
- TD4.6 Business Analytics Platform
- TD4.7 Overall IP4 Coordination and demonstration

IP5 – TECHNOLOGIES FOR SUSTAINABLE AND ATTRACTIVE EUROPEAN RAIL FREIGHT

- TD 5.0 – Business analytics and implementation strategies
- TD5.1 Freight electrification, brakes and telematics
- TD5.2 Access and Operation
- TD5.3 Wagon design
- TD 5.4 Novel Terminal, Hubs, Marshalling Yards, Sidings
- TD 5.5 New Freight Propulsion Concepts
- TD 5.6 Autonomous train operation

CCA – CROSS CUTTING ACTIVITIES

- Work Area 1 – Long-term needs and socio-economic research
- Work Area 2 – KPI method development and integrated assessment
- Work Area 3 – Safety, Standardisation, Smart Maintenance, Smart Materials & Virtual certification
- Work Area 4 – Smart Mobility
- Work Area 5 – Energy and Sustainability
- Work Area 6 – Human Capital

In the revision of the S2R MAAP part A released the 9th of November 2017, 12 capabilities which represent a concrete target for future research and innovation, have been identified:

- Automated train operation
- Mobility as service
- Logistics on demand
- More value for data
- Optimum energy use
- Serviced time to the second
- Low cost railway
- Guaranteed asset health and availability
- Intelligent trains
- Stations and smart city mobility
- Environmental and social sustainability
- Rapid and reliable R&D delivery

These capabilities are considered to be necessary to develop for delivery of an efficient future railway system that fulfils customers' expectations.

5.1.2 Horizon 2020

Horizon 2020 is the EU funding programme following the Framework programme 7 for research and innovation running from 2014 to 2020 with a €80 billion budget. This EU funding programme finances interdisciplinary projects which could have an impact on the current economic and social challenges in Europe. The programme covers the whole innovation channel from the idea to the market and fosters the market uptake of innovative research and development of SMEs. The work programmes of H2020 are prepared by the European Commission and aligned with the EU policy objectives. H2020 is constituted by the following main pillars (H2020, 2014):

- Excellent Science
- Fast track to Innovation
- Societal Challenges
- Industrial leadership
- Science with and for society
- Spreading science and widening participation
- Cross cutting activities
- EURATOM
- Smart Cyber-Physical Systems

Before 2015, the topics dedicated to railway research and innovation were announced in the pillar “Societal challenge” under the sub-call “Mobility for growth”. Since the launch of Shift2Rail in 2015, the societal challenge “Mobility for growth” does not include any more topics exclusively focused on rail as they are considered to be addressed within the Shift2Rail program.

5.1.3 Connecting Europe Facility: Transport

The Connecting Europe Facility (onwards CEF) is a key EU funding instrument to promote growth, jobs and competitiveness through targeted infrastructure investment at European level (CEF, 2014).

CEF supports the development of high performing, sustainable and efficiently interconnected trans-European networks in the fields of transport, energy and digital services. CEF investments fill the missing links in Europe's energy, transport and digital backbone. The CEF is divided into three sectors:

- CEF Energy;
- CEF Telecom;
- **CEF Transport.**

CEF Transport is the funding instrument to realise European transport infrastructure policy. It aims at supporting investments in building new transport infrastructure in Europe or rehabilitating and upgrading the existing one. The policy objectives foresee are the following:

- Completion by 2030 of the Core Network, structured around nine multimodal Core Network Corridors;
- Completion by 2050 of the Comprehensive Network in order to facilitate accessibility to all European regions.

The funding objectives are three:

- Removing bottlenecks and bridging missing links, enhancing rail interoperability, and, in particular, improving cross-border sections;
- Ensuring sustainable and efficient transport systems in the long run, with a view to preparing for expected future transport flows, as well as enabling all modes of transport to be decarbonised through transition to innovative low-carbon and energy-efficient transport technologies, while optimising safety;
- Optimising the integration and interconnection of transport modes and enhancing the interoperability of transport services, while ensuring the accessibility of transport infrastructures.

CEF Transport focuses on cross-border projects and projects aiming at removing bottlenecks or bridging missing links in various sections of the Core Network and on the Comprehensive Network as well as for horizontal priorities such as traffic management systems. CEF Transport also supports innovation in the transport system in order to improve the use of infrastructure, reduce the environmental impact of transport, enhance energy efficiency and increase safety.

€24.05 billion will be made available for the transport sector under the CEF programme for the 2014-2020 period. The majority of the funding under the CEF will be delivered in the form of grants allocated following competitive calls for proposals.

The CEF call is divided in two calls:

- Cohesion call which is aimed at Member States whose Gross National Income (GNI) per inhabitant is less than 90 % of the EU average and has an available budget of € 6.472.000.000 € (cohesion fund allocation);
- General call which is open to all EU member states and has an available budget of € 1.090.000.000 €.

Rail projects:

Concerning rail topics, CEF projects address directly the rail sector: CEF supports the realisation of a Trans-European Network in the field of rail transport:

- The EU's rail network consists of both high-speed and conventional rail lines and their related infrastructures and facilities which enable rail and other transport modes to be integrated;
- Rail projects aim to ultimately create a safe and high-quality infrastructure, by ensuring network continuity and interoperability;
- Many TEN-T rail projects (legacy programme) are devoted to the implementation of common technical standards and the European Rail Traffic Management System (ERTMS), a command and control system recommended for the European railway network;
- Some CEF projects related to the rail sector⁹ are:
 - o 2014-AT-TM-0003-W: Koralm railway line (Graz-Klagenfurt): package of implementation measures for 2014-2020;
 - o 2014-AT-TM-0082-S: Coordinated and harmonised implementation of rail freight corridors and freight and passenger telematics applications;
 - o 2014-AT-TM-0169-W: Upgrade of Austrian vehicles to ERTMS Baseline 3;
 - o 2014-BE-TA-0621-W: LoNofts - "Low Noise freight transport solution";
 - o 2014-BE-TM-0653-W: Improvement of the railway connection between Louvain-la-Neuve and Luxembourg (EuroCap-rail);
 - o 2014-BE-TM-0655-S: ETCS: development of the generic design Level 2, key catalyst for the roll-out of ETCS2 in Belgium;
 - o 2014-BE-TM-0658-S: Feasibility study on the extension of the capacity of the Brussels North-South link;
 - o Etc...

ERTMS projects:

CEF projects can also address the ERTMS implementation in Europe:

- Traffic Management Systems (TMS). Through TMS, transport can be made safer, cheaper, more reliable and "greener" and can often be done rapidly and with a smaller financial effort compared to other solutions. Some TMS applications are inherently easy to understand and we encounter them in our daily lives. Car satellite navigation systems or booking portals for

⁹ Source: <https://ec.europa.eu/inea/en/connecting-europe-facility/cef-transport/projects-by-transport-mode/rail>

- train services fall under this category. Others, such as ERTMS for instance, are less known by the general public, but are nevertheless of paramount importance for transport;
- The Agency manages a number of TMS projects, spanning all the major transport sectors (road, rail, air, water) and encourages the deployment of TMS services across all transport sectors, in line with the European Commission's priorities;
 - The total co-financing for the TMS projects managed by the Agency was over €1 billion for the 2007-2013 funding period;
 - Some CEF projects related to the ERTMS sector¹⁰ are:
 - o 2014-AT-TM-0169-W: Upgrade of Austrian vehicles to ERTMS Baseline 3;
 - o 2014-DE-TM-0057-W: ERTMS Deployment on the German part of the Rhine-Alpine Core Network Corridor;
 - o 2014-DK-TM-0183-W: ERTMS Trackside deployment along the Copenhagen H–Køge Nord–Ringsted section in East Denmark;
 - o 2014-DK-TM-0300-W: Retrofitting of vehicles with ERTMS baseline 3 - level 2;
 - o 2014-ES-TM-0510-W: ERTMS deployment on Madrid and Barcelona commuter lines;
 - o Etc...

5.2 Analysis

5.2.1 Shift2rail

Shift2Rail 2.0 should redefine the place and ambition of rail transportation in the future mobility landscape. This vision should be built in cooperation with all rail stakeholders in order to continue the good cooperation established in Shift2Rail. Building on the success of Shift2Rail, tomorrow's Shift2Rail 2.0 should take into account the ongoing mega-trends, especially in terms of urbanisation, growing interest for environmental issues and an ageing population.

The MAAP of Shift2Rail and ERRAC SRRIA have been compared to each other in the FOSTER RAIL deliverable *D5.8 Comparison between the ERRAC Strategic Rail Research and Innovation Agenda (SRRIA) and the Shift2Rail Multiannual Action Plan (S2R MAAP)* in 2016. The conclusion was that *"The main challenges of the railway sector as a transport way of transport in Europe and an important industrial sector for the European economy are shared by the SRRIA and the S2R Master Plan: Reduce the cost of transport, offer better services, increase transport capacity, contribute a more environmentally friendly world."* The difference between the ERRAC SRRIA and the S2R MAAP were attributed to the fact that the SRRIA has a long-term vision up to 2050 while the S2R MAAP is a 7 year programme.

The following topics addressed by ERRAC have been identified as **not** covered by S2R and that should be supported by H2020¹¹ (FOSTER RAIL D5.8, 2016):

IP1 Rolling Stock:

¹⁰ Source : <https://ec.europa.eu/inea/en/connecting-europe-facility/cef-transport/projects-by-transport-mode/ertms>

¹¹ A comparison between ERRAC priorities and the revised version of the S2R MAAP released in november 2017 is provided in D3.9 ERRAC- Update of ERRAC Technology roadmaps' implementation plan

- Innovative Propulsion Traction, e.g. based on hydrogen energy that will require constant investment over a long period to make it a reliable and cost-effective operational traction system;
- More efficient and smarter auxiliary equipment, e.g. Heating, Ventilation and Air-Conditioning (so called HVAC): the sector must follow closely development made in other sectors to adapt them to the rail environment for both mainline and urban lines;
- Enabling Technology: the future generation of power electronics materials i.e. diamond.

The specific needs of the urban rail sector in terms of rolling stock – metros, trams, tram-trains – need to benefit from dedicated research and innovation (onwards RIA) actions as they are not fully covered by S2R.

IP2 Control Command and Communication:

The standardization of interfaces (on-board and wayside) or performance improvements. Another topic which should receive H2020 support is the bandwidth allocation for urban rail.

IP3 Infrastructure:

Security issues of the rail infrastructure are not sufficiently addressed, especially regarding physical security. Considering the recent attacks occurring across Europe and the fact that transport is a critical infrastructure, security aspects should not be overlooked.

In addition, some elements would benefit from being supported by H2020 such as the development of smart solutions to reduce the impact of existing and aging infrastructures on environment

The specific necessities of urban rail are also often out of the S2R scope and need to be addressed, in order to reduce the Life cycle costs of infrastructure and facilitate its maintenance by taking into account the specific operational requirements of each market segment.

IP4 IT Solutions:

It is the first time that within an EU Program, this topic is comprehensively tackled. The S2R activities that gathered rail expertise and more important expertise outside the sector, will deliver step change solutions.

IP5 Freight:

S2R is only addressing the main line freight issue and is not covering the urban freight issues.

Cross Cutting Activities:

As S2R is mainly technology driven, a certain number of topics identified in the SRRIA are not covered at all, such as transport Economy, New Business Models, social and behavioural aspects, human and organisational factors etc. Research and development activities are crucial for the future of the rail transport in a rapidly evolving world in which offers possibilities. For the Rail sector, there is a clear need to anticipate the future evolution of the society as well as the future emergence of new services that could impact on the attractiveness and competitiveness of the railway sector. H2020 should support rail focused research and development activities in economics and new paradigms that could be “game changers”.

5.2.2 Horizon 2020

Among the pillars which composes the Horizon 2020 framework programme, the five pillars following present a potential opportunity to support the implementation of ERRAC priorities:

- Excellent Science;
- Fast track to Innovation;
- Societal Challenges;
- Industrial leadership;
- Spreading science and widening participation.

The figure 3 below represents a mapping of pillars and challenges/sub programmes of Horizon 2020 relevant to ERRAC.

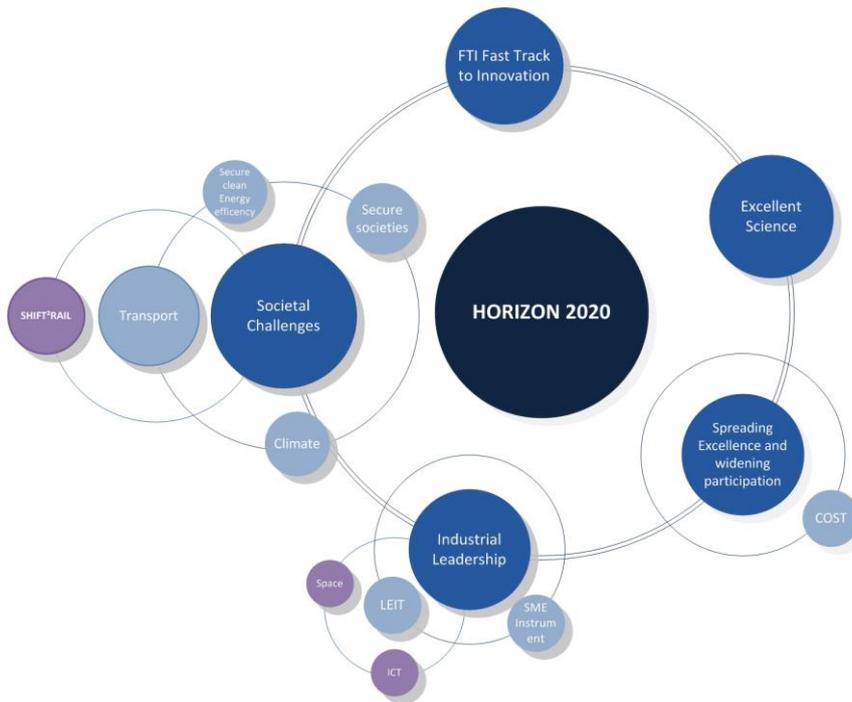


Figure 3: Map of implementation opportunities of ERRAC priorities within H2020
 Source: SETRIS project

The table 1 below describes the different H2020 pillars and challenges mapped in figure 3 and their relevance for ERRAC and the railway sector at global scale.

Table 1:H2020 pillars and challenges relevant to ERRAC priorities

Source: SETRIS project Pillars	Challenges/sub programmes	Description	Relevance with the railway sector/ ERRAC
Societal Challenge	Smart, green and integrated transport	This challenge aims to foster the competitiveness of the European transport industry and to move toward a fully integrated transport system.	<i>This programme is highly valuable for the railway sector as it tackles multi-modal challenges and issues, and therefore complement the railway research activities within a multimodal system.</i>

	Secure and clean energy	The purpose of this challenge is to support the transition to a reliable, efficient and competitive energy system.	<i>The railway system is very dependent on the energy system for the powering of trains but also infrastructure. As end user, this is an important topic for the railway sector.</i>
	Climate action, environment, resource efficiency and raw Materials	This challenge will enable ecosystems and society to adapt to climate change and other environmental changes.	<i>As the most environment friendly transport mode, railways are particularly dedicated to investing effort in this challenge in order to maintain this leadership position.</i>
	Secure societies	This challenge aims at undertaking the research and innovation activities required to protect European citizens, society and economy.	<i>Being a critical infrastructure, the rail transport is particularly concerned by this challenge.</i>
Industrial Leadership	Leadership in enabling and industrial technologies: Space	The purpose of “space” is to foster a cost-effective competitive and innovative space industry to develop and exploit space infrastructure to meet future EU policy and societal needs.	<i>Satellite-based technologies such as train satellite positioning technology are important for the railway sector regarding the development of ERTMS and innovative health monitoring systems</i>
	Leadership in enabling and industrial technologies: ICT ¹²	ICT creates innovation and competitiveness across a broad range of private and public markets and sectors.	<i>ICTs may underpin new paradigms in innovation and competitiveness of the railway sector.</i>
	SME instrument	The SME-instrument actively supports SMEs by providing both direct financial support, and indirect support to increase their innovation capacity.	<i>The SME-instrument offers the opportunity for SMEs to bring to the market railways innovative technologies supporting the implementation of the ERRAC technology roadmap.</i>

¹² Information and Communications Technology

Fast track to innovation		The objective Fast Track to Innovation (FTI) pilot ¹³ of to promote close-to-the-market innovation activities, and open to all types of participants.	<i>FTI offers the opportunity to promote innovative railway technology which are close to market uptake.</i>
Excellent science		Activities under this Pillar aim to reinforce excellence in Europe and to consolidate the European Research Area.	<i>This pillar is interesting to support the research and innovation activities carried out by the railway researchers.</i>
Spreading excellence and widening participation	COST	By providing cross-border scientific networking, COST helps excellent researchers and innovators get access to European and international networks.	<i>COST provides networking and dissemination channels which could be used to promote innovative railway research projects supporting the ERRAC technology roadmaps.</i>

Indeed, the next Multiannual Financial Framework should foresee as well as an ambitious EU support for rail Research and Innovation (onwards R&I) in the framework of the upcoming 9th Framework Programme (next H2020 Programme) for Research and Innovation (FP9). Due its key role for social inclusion, economic growth and environmental sustainability, and taking into account the modal shift objectives of the 2011 Transport White Paper, the future budget dedicated to transport R&I should clearly give priority to rail transport.

5.2.3 Connecting Europe Facility: Transport

Connecting Europe Facility (CEF) Transport grants have provided crucial support to the achievement of the TEN-T Policy objectives and the development of sustainable transport system. The rail system has been a key beneficiary of the funds available under the CEF, which were increased threefold compared to TEN-T funding in the 2007-2013 period.

Regarding railways, CEF transport focuses on the development and modernisation of railway infrastructure and the deployment of ERTMS. CEF is not a research and innovation program but it is a valuable tool for the implementation of efficient and innovative technologies supporting rail interoperability and removing bottlenecks of rail operations. CEF is therefore important for ERRAC, as it has been shown in section 3.3, railway infrastructure development and modernisation is a major concern for east EU members. The high demand for EU co-funding was exemplified by the 2014, 2015 and 2016 CEF Transport Calls, which were all significantly oversubscribed. This very high demand for CEF funding and the strong project pipeline indicates that the budget should be increased further in the next MFF.

Even if CEF is not a research and innovation program, bilateral exchanges with research will be very profitable, as lessons learnt from these implementation projects would significantly enrich the state of

¹³ The Commission has proposed to continue the FTI under the remit of a European Innovation Council Pilot, which should be launched upon the adoption of the Horizon 2020 Work Programme 2018-2020 at the end of October 2017.

the art in fields related to railway infrastructure development and modernisation and in return research and innovation initiatives could build upon this knowledge new enabling technologies removing bottlenecks, optimized implementation methods, and guidelines for future implementation and modernization projects. In addition, the upgrade of urban railway systems should be also considered (e.g. Communications-based train control –CBTC- systems).

In this context, the CEF should continue to be the cornerstone of the EU Investment Policy in the transport sector also in the post-2020 period. Financial support through CEF grants will be vital for the development of the TEN-T Core Network Corridors that are key to bridge the gaps and bottlenecks, thus increasing the competitiveness of the European rail system.

There should be dedicated CEF funding made available to foster automation and digitalisation of the railway sector. This will contribute to a more performing and attractive railway in the interest of the customers and the society. The combination of Automated Train Protection (ERTMS), Automated Train Operations and Automated Train Supervision will increase capacity, performance (punctuality and speed), interoperability, safety and last, but not least, productivity. Notably, the ERTMS deployment will require additional resources in order to accelerate its rapid roll-out (especially in the framework of the revised European ERTMS Deployment Plan adopted in January 2017) and unlock the economies of scale and efficiency gains that it will bring to the rail system. Making digital railways a priority will also spread positive effects with regard to improving maintenance systems and procedures. In this regard, a ring-fenced budget for smarter maintenance of existing infrastructure should be considered.

CEF eligibility should also be extended to rail rolling stock in order to support the decarbonisation of the rail system thanks to more energy efficient and/or trains using alternative fuels, thus reducing the number of diesel engines in service.

It will be also important to increase support to the urban nodes located on the TEN-T Core Network, and to provide adequate grants support for sustainable transport infrastructure and rolling stock projects. Virtually all passenger journeys start or finish in urban areas; therefore, the quality and efficiency of urban public transport infrastructure and services must be ensured.

6. RECOMMENDATIONS AND CONCLUSIONS

D3.8 provides the identification of the synergies between the relevant national and EU programmes which could support the implementation of ERRAC priorities. For the study carried out in the deliverable, it results that national priorities are aligned with the ERRAC priorities and EU programme comply with the implementation of ERRAC technology roadmaps.

Based on the analysis of the railway research priorities of national governments and EU programs, the following recommendations can be drawn up:

- **Encourage research initiatives that will enable the implementation of ERRAC:** Shift2Rail addresses many of the technological challenges that needs to be tackle by the railway sector, but not all, thus to ensure the competitiveness and the adaption of the railway transport mode to society needs and changes, it is necessary to implement all areas of research defined in ERRAC roadmaps. Rail research initiatives should not only be limited to rail, consider related societal aspects and include cross cutting fields such as human and organizational factors, public health, economy and finance, spatial strategy, energy and environment. In addition, urban transport at city level, not only as a mode to fulfill the first and last miles of a journey, should be considered. Rail urban travels may start and finish in the same city. However, they should be considered as part of the S2R ecosystem, as there is more than a mean to complete long-distance travels. In 2050 more than 60% of the European population will be urban so will be the main part of the journeys.
- **Maintain and develop relation with NTPs and national initiatives by taking in account regional disparities:** as this report shows, the priorities of national master plans are in most case aligned with ERRAC priorities. But in term of implementation of rail research initiatives, not every country in the study had a research program dedicated to railway research. It is therefore important that ERRAC develops and maintains its relations with NTPs and national government but also takes in consideration the disparities in Europe and adapts, in accordance, its strategy for the promotion of railway research and knowledge.
- **Raise awareness about the digital revolution and new paradigms that could be developed from enabling technologies:** as the study shows digital technologies are not always identified as main priorities in the majority of transport/railway master plan. It is the role of ERRAC to promote enabling technologies in the European railway sector. Regional disparities should of course be taken in account and emphasis should be put on technologies with high return of investment.
- **Enhance collaboration with transport ETPs to support the achievement of the integrated transport system:** ETPs should work together and in a coordinated manner in order to make the integrated transport system a reality. In this prospect, ERRAC members will actively work on their participation in H2020 research and innovation activities related to intermodal transport. The role of ERRAC in this collaboration is also to incentivize that rail is a privileged backbone of the future integrated transport system in Europe and ensure that financial investments are distributed accordingly.
- **Further develop relations with the ECTP to tackle the challenges of the future railway infrastructure:** despite the growing demand for railway infrastructure, driven by rapid urbanization, road congestion and societal demands for a green mobility, railway infrastructure assets are aging and need to be modernized in many areas. A high level of investment is especially required for mainline infrastructure. Railway infrastructure is a key item for the European transport system, the collaboration between ERRAC and the ECTP is necessary to exhaustively address the challenges of the future infrastructure (including maintenance).

-
- **Investigate the possibility of further exchanges with CEF transport:** lessons learnt and data from CEF transport projects would significantly enrich the state of the art in fields related to railway infrastructure and research and innovation bodies could improve this knowledge with new enabling technologies, optimized implementation methods and guidelines. There should be dedicated CEF funding made available to foster automation and digitalization of the railway sector. CEF eligibility should also be extended to rail rolling stock in order to support the decarbonisation of the rail systems. It will be also important to increase support to the urban nodes located on the TEN-T Core Network, and to provide adequate grants support for sustainable transport infrastructure and rolling stock projects. Virtually all passenger journeys start or finish in urban areas; therefore, the quality and efficiency of urban public transport infrastructure, interchanges and services must be ensured.

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8. APPENDIX A: QUESTIONNAIRE TO THE NCP

COUNTRY	
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Please provide a short overview of the national transport policy especially the railway related issues

Please provide a short overview of the Transport Research Policy and Research Initiatives

Please provide some information about National transport research funding sources

Please provide a short overview of the National rail research priorities

Please provide a short overview of the main rail research organisations and area of expertise

Please provide some information about the National research data base (if any)

Please provide a short overview of relevant National rail research projects

Please provide a short overview of participation in cross-border and EU funded rail research projects

Could you please indicate a few of the important national universities, companies, operators and organisations who could contribute or are already are contributing to the development of the European rail market segments? (name and contact person)

9. APPENDIX B: STAKEHOLDER REVIEW OF THE ERRAC COMMUNITY

Questionnaire:

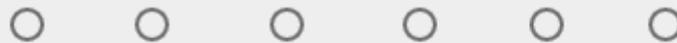
Please rate the importance of the following actions that ERRAC could engage in? *

	Not important	Slightly important	Moderately important	Very important	Extremely important	No opinion
Encourage research initiatives that will enable the implementation of ERRAC roadmaps and ensure the competitiveness and the adaption of the railway mode to society needs and changes	<input type="radio"/>					
Maintain and develop relation with NTPs (National Transport Platform) and national initiatives with emphasis on european and regional disparities	<input type="radio"/>					
Raise awareness about the digital revolution and new paradigms that could be developed from enabling technologies: digital technologies are not always identified as main priorities in national transport master plans and strategies	<input type="radio"/>					
Enhance collaboration with transport ETPs to support the achievement of the integrated transport system: ETPs should work together and in a coordinated manner in order to make the integrated transport system a reality	<input type="radio"/>					

Further develop relations with the ECTP (European Construction Technology Platform) to tackle the challenges of the future railway infrastructure: despite the growing demand, railway infrastructure assets are aging and need to be modernized in many areas



Investigate the possibility of further exchanges with CEF transport: lessons learnt and data from CEF transport projects would significantly enrich the state of the art in fields related to railway infrastructure and research and innovation bodies



In your opinion, what other actions (not mentioned above) could ERRAC engage in in the future?

Your answer

Results:

14 people answered the questionnaire. The could be answered anonymously, but the possibility of providing contact and geographic information was given. 8 people answered the questionnaire anonymously, 6 people indicated their country which were France (2), Germany (1), Belgium (1), Spain (1) and Czech Republic (1).

The results of the survey are the following:

	No opinion	Not important	Slightly important	Moderately important	Very important	Extremely important
Encourage research initiatives that will enable the implementation of ERRAC roadmaps and ensure the competitiveness and the adaption of the railway mode to society needs and changes	1	0	0	0	2	11
Maintain and develop relation with NTPs (National Transport Platform) and national initiatives with emphasis on European and regional disparities	1	0	0	2	7	4
Raise awareness about the digital revolution and new paradigms that could be developed from enabling technologies	1	0	0	3	4	6
Enhance collaboration with transport ETPs to support the achievement of the integrated transport system	1	0	0	2	3	8
Further develop relations with the ECTP (European Construction Technology Platform) to tackle the challenges of the future railway infrastructure	0	0	0	2	9	3
Investigate the possibility of further exchanges with CEF transport: lessons learnt and data from CEF transport projects	0	0	1	1	7	5

In your opinion, what other actions (not mentioned above) could ERRAC engage in in the future?

“Include systematically the human and organisational factors in the discussions. making project without thinking about Human and organisational factors is dangerous for the project and a source of risk for the workers and/or the management of the activities.” *(added to the first recommendation)*

“Identifying issue-led challenges which are not limited just to rail - eg public health, spatial strategy, energy, digital opportunity etc “*(added to the first recommendation)*

“to make sure European funds for research & innovation activities are well shared between all transport modes (not only aeronautics and road transports) and all research & innovation actors (especially SME & technology providers).” *(added to the third recommendation)*

Validation of the recommendations:

To validate by the greater ERRAC community, the recommendations identified in deliverable D3.8, the following rating scale were used:

Level of importance	No opinion	Not important	Slightly important	Moderately important	Very important	Extremely important
Rating scale	Not considered	0	1	2	3	4

The average and standardised rate by recommendations are the following:

	Recommendation rating
Encourage research initiatives that will enable the implementation of ERRAC roadmaps and ensure the competitiveness and the adaption of the railway mode to society needs and changes	3,8
Maintain and develop relation with NTPs (National Transport Platform) and national initiatives with emphasis on European and regional disparities	3,2
Raise awareness about the digital revolution and new paradigms that could be developed from enabling technologies	3,2
Enhance collaboration with transport ETPs to support the achievement of the integrated transport system	3,5
Further develop relations with the ECTP (European Construction Technology Platform) to tackle the challenges of the future railway infrastructure	3,1
Investigate the possibility of further exchanges with CEF transport: lessons learnt and data from CEF transport projects	3,1

All recommendations are rated between **Very important** and **Extremely important**.