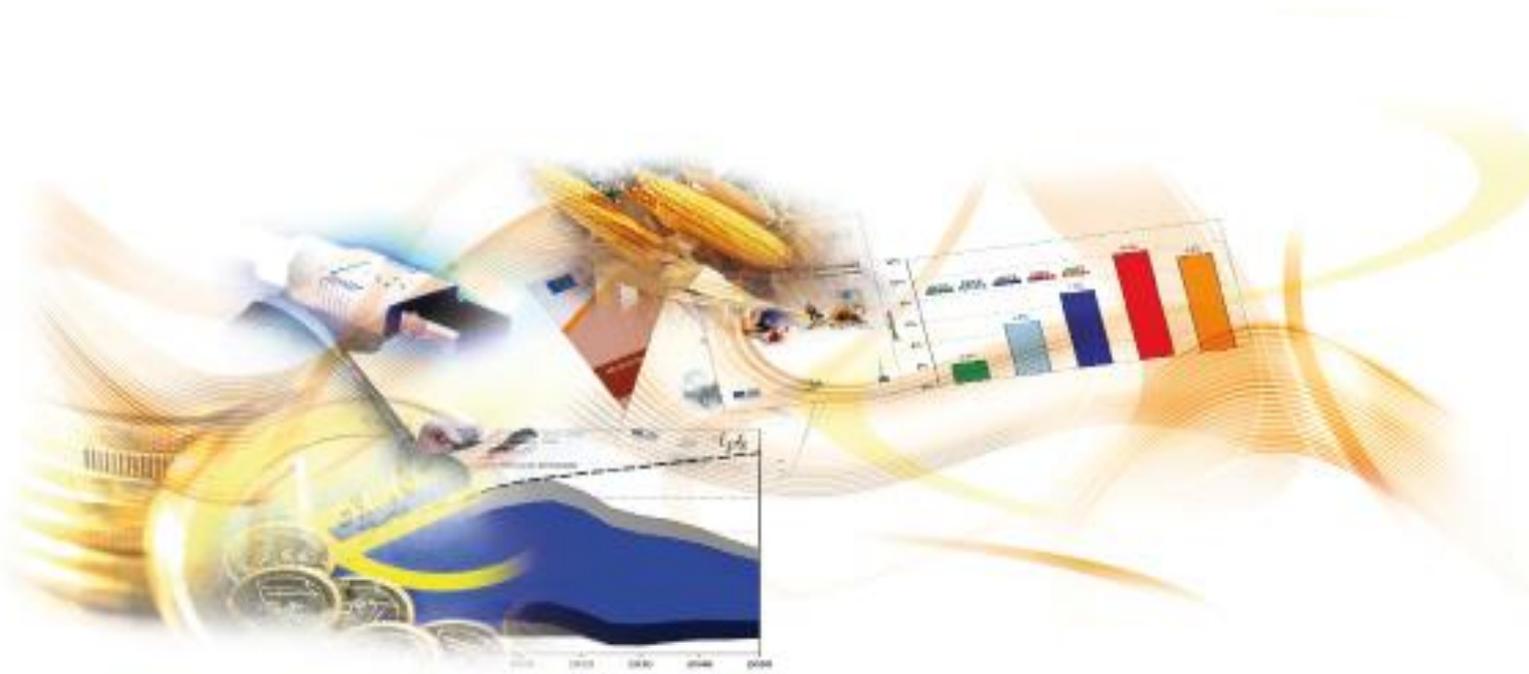


JRC TECHNICAL REPORTS



Smart guide on regional transport innovation strategy

Transport innovation roadmaps

Ana Condeço-Melhorado, Aris Christodoulou, Panayotis Christidis
2015

Report EUR 27502 EN

European Commission
Joint Research Centre
Institute for Prospective Technological Studies

Contact information

Panayotis Christidis
Address: Edificio Expo. c/ Inca Garcilaso, 3. E-41092 Seville (Spain)
E-mail: jrc-ipts-secretariat@ec.europa.eu
Tel.: +34 954488318
Fax: +34 954488300

JRC Science Hub
<https://ec.europa.eu/jrc>

Legal Notice

This publication is a Technical Report by the Joint Research Centre, the European Commission's in-house science service. It aims to provide evidence-based scientific support to the European policy-making process. The scientific output expressed does not imply a policy position of the European Commission. Neither the European Commission nor any person acting on behalf of the Commission is responsible for the use which might be made of this publication.

All images © European Union 2015

JRC96777

EUR 27502 EN

ISBN 978-92-79-52294-9 (PDF)

ISSN 1831-9424 (online)

doi:10.2791/34368

Luxembourg: Publications Office of the European Union, 2015

© European Union, 2015

Reproduction is authorised provided the source is acknowledged.

Abstract

This guide provides regions with information and guidelines useful for the development of smart specialisation strategies (RIS3) in transport. The guide follows the six steps for Smart Specialization with a special focus in transport. The six steps include the analysis of the regional context and potential for innovation, the discussion of governance structure, the development of a shared vision about the future of the region, approaches for the selection of transport related priorities for regional development, policy mixes and options for the integration of monitoring and evaluation mechanisms. The recommended process consists of a bottom-up analysis of regional capabilities of the industry and scientific community that needs to be aligned with national and European objectives. At the European level, the Strategic Transport Technological Plan (STTP) identifies ten innovation areas that will be extremely important for the future competitiveness of the transport sector. The guide also analyses different innovation area in the context of RIS3 methodology, showing specific examples and roadmaps on how these could be implemented in the regional innovation strategies. Finally tools are offered to analyse the innovation potential, performance and priorities in the transport sector, such as data and indicators regarding regional transport innovation, as well as methodologies to analyse innovation capabilities of European regions.

Acknowledgements

This guide is one of the main outcomes of METRIC¹, an FP7 project that focused on mapping the regional transport innovation capacity and competitive advantages of European regions. It is the result of work package 5 which focused on 'Regional Strategy Plans and Recommendations'. The authors would like to thank all partners of this project for inputs provided in this work package both regarding data and suggestions.

¹ <http://metricfp7.eu/>

Executive Summary

Under the current Cohesion Policy funding period (2014-2020), EU regions are expected to define national and regional innovation strategies for smart specialisation (RIS3) as ex-ante conditionality for European Structural and Investment Funds (ESIF). These strategies should be integrated, location-dependent economic transformation agendas that focus policy support and investments on key national and regional priorities, based on existing strengths and competitive advantages.

Many regions have identified the transport sector as a priority in their regional innovation strategies², given its economic weight in terms of value added and employment levels. This sector is also highly innovative, especially in the aeronautic and automotive sub-sectors.

Regional and national authorities wishing to use ESIF in research and innovation in the transport will need to include this sector into national/regional Research and Innovation Strategies for smart specialization.

This guide provides regions with information and guidelines useful for the development of Smart Specialisation Strategies in transport. Furthermore, it presents a set of recommendations and tools for the development of regional transport innovation plans.

The first part of this guide follows the six steps for Smart Specialization developed in more detail in the original Guide to Research and Innovation Strategies (European Commission, 2012) which was already adopted for the ICT sector (Sörvik, J. and Kleibrink, A., 2014). The current guide provides a special focus in transport. The six steps include:

1. Analysis of the regional context and potential for innovation;
2. Set up a sound and inclusive governance structure;
3. Production of a shared vision about the future of the region;
4. Selection of a limited number of priorities for regional development;
5. Establishing of suitable policy mixes;
6. Integration of monitoring and evaluation mechanisms.

For the selection of priorities, the recommended process consists of a bottom-up analysis of regional capabilities of the industry and scientific community that needs to be aligned with national and European objectives (top-down). At the European level, the Strategic Transport Technological Plan (STTP) identifies ten innovation areas that will be extremely important for the future competitiveness of the transport sector.

The current guide analyses each innovation area in the context of RIS3 methodology, showing specific examples and roadmaps on how these could be implemented in the regional innovation strategies.

Additionally, tools are offered to help regional stakeholders to analyse the innovation potential, performance and priorities in the transport sector, such as data and indicators regarding regional transport innovation, as well as methodologies to analyse innovation capabilities of European regions.

² Around 6% of priorities defined by regions in their smart specialisation strategies, see transport as a target market (Sörvik, J. and Kleibrink, A., 2015)

Contents

Acknowledgements	1
Executive Summary.....	3
Introduction.....	7
Part 1 - Six steps for a successful smart specialization strategy	10
Step 1 – Analysis of the regional context and potential for innovation	12
Step 2 – Set up a sound and inclusive governance structure	18
Step 3 – Elaboration of an overall vision for the future of the region.....	19
Step 4 – Identification of priorities.....	20
Step 5 – Definition of coherent policy mix, roadmaps and action plan.....	24
Step 6 – Integration of monitoring and evaluation mechanisms	27
Part 2 - Developing transport innovation strategies	31
Clean, efficient, safe and smart road vehicles	34
Clean, efficient, safe, quiet and smart aircrafts	37
Clean, efficient, safe, quiet and smart rail vehicles	42
Clean, efficient, safe, quiet and smart vessels.....	46
Smart, green, low-maintenance and climate-resilient infrastructure	50
Europe-wide alternative fuel distribution infrastructures	55
Efficient modal traffic-management systems	58
Integrated cross-modal information and management services	62
Seamless logistics	65
Integrated and innovative urban mobility and transport	69
Part 3 - Tools and services for regional innovation strategies in transport.....	74
METRIC Project tools	76
Support provided by the Commission services and other institutions.....	79
Conclusions	82
References	83

List of figures

Figure 1 – Examples of regional assets involved in the regional innovation system.....	13
Figure 2 - The EU transport scoreboard.....	14
Figure 3 - The quadruple helix model of innovation	18
Figure 4 – List of potential transport stakeholders.....	19
Figure 5 – Interactive process for the identification of priorities	20
Figure 6 – Transport innovation fields presented by the STTP	23

List of tables

Table 1 – SWOT analysis for the automotive sector in Turkey	15
Table 2 – Opportunities for synergies between Horizon 2020 and Cohesion policy	25
Table 3 – Example of context indicators	27
Table 4 – Examples of result indicators.....	28
Table 5 – Examples of outcome indicators.....	29
Table 6: Transport innovation indicators	78

List of boxes

Box 1 - Regional collaboration on transport issues: The EU strategy for the Danube region (EUSDR)	17
Box 2 – J'innove in Nord-Pas de Calais.....	17
Box 3 - Poitou-Charentes vision.....	20
Box 4 – Successful projects funded by ERDF in the area of transport innovations	26
Box 5 - The regional innovation observatory of Provence-Alpes-Côte d'Azur region	30
Box 6 - Laboratory of reactivity and chemistry of solids (France)	37
Box 7 - The Andalusian aerospace cluster (OECD, 2013)	39
Box 8 - RAILENIUM – Institute for technological research (Source: http://www.railenium.eu).....	45
Box 9 - LeaderSHIP 2020	49
Box 10 - Innovative Danube Vessel.....	50
Box 11 – Greenroad project	54
Box 12 - Magnun Cap's New Park Charge Solution	58
Box 13 - New Centre of Excellence in North-Western Slovakia	61
Box 14 - LOGICAL project	65
Box 15 - Finland's multi-modal transport service package.....	65
Box 16 - Competence field logistics & transport, ecoplus	68
Box 17 - The Zurich transport system	70
Box 18 - Future Bristol	73

Introduction

The smart specialisation concept builds upon the idea of focusing the R&D and innovation efforts in programs that will complement the regional assets while creating a comparative advantage for the region. One of the final objectives of smart specialization is the promotion of a structural change through cross-innovation between sectors and the use of technologies to bring traditional sectors to a higher innovation level (Foray, D, 2015). This way, agglomeration externalities, economies of scale and scope, and spillovers can be fully realised in the process of knowledge production and distribution.

This concept has been developed and put in practice by the Smart Specialisation Platform (S3P), which has also developed a method to implement a strategy for smart specialisation in national/regional contexts (European Commission, 2012). Under the current Cohesion Policy funding period (2014-2020), EU regions are asked to draw up national/regional innovation strategies for smart specialization (RIS3) as ex-ante conditionality for European Structural and Investment Funds (ESIF). These strategies are integrated, place-based economic transformation agendas that focus policy support and investments on key national/regional priorities, based on existing strengths and competitive advantages.

The transport sector is pointed as a priority for many regions in their RIS3. This is a crucial economic sector for the EU's economy, constituted by a diverse range of companies, such as transport manufacturers, transport suppliers, infrastructure constructors, service providers or energy-related firms. The transport sector contributes with high employment levels in Europe, providing highly qualified jobs in sectors such as the automotive or civil aircraft manufacturing. The European transport sector is highly innovative, being responsible for 21% of total 2011 Business Enterprise R&D (BERD, Eurostat) in the EU 28, but it differs largely on the transport subsector analysed. The aeronautic and automotive sectors are among the most innovative transport subsectors, while service providers have limited innovation capacity (Condeço-Melhorado, A., 2014).

The EU is well aware of the importance of the transport sector for its internal market and worldwide economic competitiveness. The European Structural Investment Funds (ESIF) are one of the main policy instruments available for transport investments, which include five sources of funding:

- 1) European Regional Development Fund (ERDF)
- 2) European Social Fund (ESF)
- 3) Cohesion Fund (CF)
- 4) European Agricultural Fund for Rural Development (EAFRD)
- 5) European Maritime & Fisheries Fund (EMFF)

These funds support the Europe 2020 strategy and devote one of its Thematic Objectives (TO) directly to transport: TO 7 'Promoting sustainable transport and removing bottlenecks in key network infrastructures'³. Other TOs can be used to transport policies, such as TO 4 'Shift towards a low carbon economy' or TO 1 'Strengthening research, technological development and innovation'.

Regional and national authorities wishing to use ERDF in research and innovation in transport can apply for the R&D target of TO 1. However they will need to adopt national/regional Research and Innovation Strategies for Smart Specialization (RIS3), as ex-ante conditionality.

³ Common Provisions Regulation (CPR) No1303/2013

Main objective of the guide

The main purpose of this guide is to provide regions with information and guidelines useful for the development of Smart Specialisation Strategies in transport. This is one of the main outcomes of METRIC⁴, an FP7 project that focused on mapping the regional transport innovation capacity and competitive advantages of European regions. This guide presents a set of recommendations and tools for the development of regional transport innovation plans.

Furthermore technology-specific transport innovation roadmaps for ten transport fields are developed. The transport innovation roadmaps are structured around the ten technological fields that have been identified in the Strategic Transport Technology Plan (European Commission, 2012a) and, besides the rationale, barriers and challenges regarding each sector, they follow an analytical process that highlights key issues relevant to the steps of the smart specialisation structure.

The tools and recommendations provided in this guide can be useful for the development of innovation plans and the benchmarking of regions. Specific tools for the transport sector have been developed in METRIC for regional evaluation, including:

- a) Regional transport innovation scoreboard that consists of a selection of indicators presented in Konings and Louw (2014a)
- b) Innovation performance in terms of achievements (Konings et al., 2014b),
- c) Innovation potentials (Hoppe and Winter, 2014a)
- d) Typology of regions (Hoppe and Winter, 2015b)
- e) Tool-box for determining regional innovation potential (Hoppe and Winter, 2015c)
- f) Benchmarking of regions (Christodoulou, A. et al., 2015)

The Target Audience

The guide is targeted at Structural Funds managing authorities, policy-makers and transport stakeholders that could be involved and benefit from the implementation of Smart Specialization Strategies.

RIS3 processes have already started/finalised in many EU regions. For those regions, the current guide offers the possibility to revise their innovation strategies with specific information that relates the RIS3 methodology with the transport sector. The information provided in this guide can also be useful for other regions that plan to include the transport sector in future RIS3 revisions. Other transport stakeholders (i.e. industry, universities) may use this guide as an overview of the RIS3 process that regions are following in order to meet the ex-ante conditionality of ESIF.

⁴ <http://metricfp7.eu/>

Structure of the guide

Part 1

Part 1 briefly presents the six steps for Smart Specialization developed in more detail in the original Guide to Research and Innovation Strategies (European Commission, 2012). This includes : 1) Analysis of the regional context and potential for innovation; 2) Set up a sound and inclusive governance structure; 3) Production of a shared vision about the future of the region; 4) Selection of a limited number of priorities for regional development; 5) Establishing of suitable policy mixes; 6) Integration of monitoring and evaluation mechanisms.

Part 2

Part 2 associates specific technological fields with Smart Specialisation Strategies (RIS3). Ten critical transport areas for transport were selected based on the Strategic Transport Technology Plan (STTP) (European Commission, 2012a). Roadmaps for including the ten transport innovation fields into RIS3 are presented.

Part 3

Part 3 presents some tools that can be used by regions in order to analyse their innovation activity and to compare this innovation activity with other European regions. The first section includes the tools coming out from the analysis that was conducted during the METRIC project. The second section presents more general tools and services that can be used for regional innovation strategies.

Part 1 - Six steps for a successful smart specialization strategy

Part 1 - Six steps for a successful smart specialization strategy

Following the original Guide to Research and innovation Strategies for Smart Specialization⁵ (European Commission, 2012), this section is structured around six steps:

1. Analysis of the regional context and potential for innovation
2. Set up a sound and inclusive governance structure
3. Production of a shared vision about the future of the region
4. Selection of a limited number of priorities for regional development
5. Establishing of suitable policy mixes
6. Integration of monitoring and evaluation mechanisms

Step 1 – Analysis of the regional context and potential for innovation

This step aims the analysis of existing assets and the prospects for future development within a region. The analysis should cover three main dimensions:

- Regional assets, such as technological infrastructures
- Links with the rest of the world and the position of the region within the European and global economy
- Dynamics of the entrepreneurial environment

The first dimension is the **assessment of regional assets** focusing on strengths and weaknesses of the region, while identifying any bottleneck and key challenges that may exist for driving the innovation within the region. In this step it is important to look at companies' needs and barriers to innovation while assessing the support to innovation provided by the infrastructure existing in the region. This dual analysis will reveal the gap between companies' needs and demand for support and will evaluate the relevance and effectiveness of existing infrastructures. This process may lead to proposals for improvements of existing innovation infrastructure and better use of public funds.

When identifying the regional assets it is important to look at potential ways of diversifying the existing know-how. However, this diversification should point to feasible and accessible objectives. At this stage it is important to look at any existing differentiation patterns that may emerge from the interaction between well-established firms and new activities.

Some tools are especially suited for this purpose such as the SWOT analysis, taking into account the regional assets involved in the regional innovation system (Figure 1). For this analysis, all relevant stakeholders should be identified and consulted about the importance and effectiveness of existing infrastructure. Key transport indicators such as the ones in the EU Transport Scoreboard

⁵ <http://s3platform.jrc.ec.europa.eu/documents/10157/267027/RIS3%20Guide.pdf>

Figure 2) should also be considered, together with other general economic performance indicators such as GVA, turnover, production and employment, to assess the transport sector in the regional context. Table 1 shows an example of SWOT analysis for automotive sector in Turkey.

Figure 1 – Examples of regional assets involved in the regional innovation system

Knowledge generation	<ul style="list-style-type: none"> •Universities •Excellence Centres •Research centres
Technological development	<ul style="list-style-type: none"> •Technological corporations
Application	<ul style="list-style-type: none"> •Industrial / public R&D facilities •Laboratories
Support and marketing	<ul style="list-style-type: none"> •Technological parks •Incubators •Risk capital •Public bodies supporting R&D activities
Social agents	<ul style="list-style-type: none"> •NGO's •Trade Unions

Source: Own elaboration

Figure 2 - The EU transport scoreboard



Source: http://ec.europa.eu/transport/facts-fundings/scoreboard/index_en.htm

Table 1 – SWOT analysis for the automotive sector in Turkey

Strengths	Opportunities
<ul style="list-style-type: none"> - Unsaturated Domestic Market - Compatibility with the EU Customs Union and the technical compliance - Geographical location (proximity to the EU markets and largest domestic markets) - High Innovation Capacity - Flexible production with competitive costs and risk sharing value chain - Sophisticated demand structure - Strong Position in International Trade - Competitive sub-contractors and suppliers - High standards of quality in production - Well-educated, young, dynamic and highly motivated qualified workforce - Flexible and long working hours - The high level of technical and commercial skills - Ability to adapt to changes, standards, production and global conjecture - • The high level of “Know-How” of the suppliers due to foreign partnerships 	<ul style="list-style-type: none"> - Increase in domestic demand - Newly emerging opportunities within the global markets and neighbouring countries (New Export Markets) - Relatively low costs compared to the EU - Joint projects that suppliers are involved at the very beginning; in design processes within the production chain - The on-going studies dedicated to ensure the compatibility with the EU Legislation
Weaknesses	Threats
<ul style="list-style-type: none"> - The lack/minority of firms with Co-Design capability and the low rates of domestic value added - The lack/minority of test centres - The high levels of motor vehicle taxes and also the high level of taxes on fuel products - The incompatibility of the legislation on motor vehicle taxes with the EU Legislation - Inconsistency of demand due to sudden and high increases in taxes rates - Non-competitive support legislation compared to competitor countries - Bureaucracy in foreign trade procedures - High costs of energy - Low quality in fuel products - Insufficient transportation infrastructure - The insufficient integration and synergy between OEMs and suppliers - Insufficient export support schemes - High interest rates and high input costs - Increase in costs that are not reflected to retail prices - • Inadequacy of industrial design capabilities 	<ul style="list-style-type: none"> - Second hand vehicle imports from the EU - Uncertainties in studies conducted in energy efficiency and environment legislation - Enormous increases in raw materials - Negative Impacts of Revaluation of TL on Exports - The rise of China, India and East-Europe countries in terms of low costs - Delay in capacity building and technological investment decisions

Source: (TUBITAK, in OECD, 2013)

The region should **look beyond its regional boundaries** and compare itself with other similar regions, in order to identify competitive advantages both in the national and international context. It is also important that the region identifies relevant links of flows of goods, services and knowledge with other regions in order to show possible patterns of integration with partner regions and the position of regional firms in international value chains. Collaboration between regions is considered one important aspect in the RIS3 because it will: i) minimize the risk of duplication of investments in other European regions; ii) promote complementarities between regions and; iii) achieve critical mass to solve common challenges. In the EU there are some examples of good practices regarding regional collaboration in transport issues, as in the case of Danube region or the Baltic Sea region (See Box 1).

Proposed tools for this kind of analysis are comparative studies, rounds of interviews with other regions and interregional work groups. General statistics from official data sources that compare the region with the country, other similar regions and the EU, in terms of economic performance; innovation capacity; educational levels; sectorial specialization; scientific specialization, will be useful to position the region in the national and European context. Other useful tools are the European Cluster Observatory⁶, the Eye@RIS3⁷ and the Benchmarking Regional Structure⁸ (See Part 3 of this report).

The smart specialization requires the **participation of entrepreneurs** which have a good knowledge of areas with the greatest potential to evolve. To evaluate the dynamics of entrepreneurs it could be useful to look at statistics on entrepreneurial activities, and promote rounds of consultations with cluster management and firms, working groups and observatories as well as monitoring organization. These consultations should provide additional information about their innovation capacity, their main competitiveness advantages as well as the main barriers encountered in the innovation process. Furthermore it is also important to understand the links between entrepreneurs and their main clients and suppliers. A questionnaire similar to the Community Innovation Survey (CIS) could serve as a basis to gather this information. Some regions have developed interesting tools to map the innovation potential of regional entrepreneurs. This is the case of J'innove in Nord-Pas de Calais (seeBox 2)

⁶ <http://www.clusterobservatory.eu/index.html#!view=aboutobservatory;url=/about-observatory/>

⁷ <http://s3platform.jrc.ec.europa.eu/eye-ris3>

⁸ <http://s3platform.jrc.ec.europa.eu/regional-benchmarking>

Box 1 - Regional collaboration on transport issues: The EU strategy for the Danube region (EUSDR)

In 2010, the European Commission proposed a strategy to boost the development of the Danube Region that was finally endorsed by Member States in 2011. This region includes both EU and non-EU countries, with different levels of innovation capacity (<http://www.danube-region.eu/>).

The strategy provides a framework to address challenges that require transnational cooperation in the field of environmental threats, transnational transport corridors, energy, socio-economic development, education, research and innovation and safety and security issues.

The strategy is organized around four pillars: (1) Connecting the Danube region; (2) Protecting the environment in the Danube region; (3) Building prosperity in the Danube region; (4) Strengthening the Danube region; and 11 functional Priority Areas, from which two are directly related with transport (Inland waterways, and Rail, road and air transport). Several transport-related projects have been started in the fields of infrastructure construction and management, sustainability, fleet modernization, and information services.

Smart Specialization strategies are especially useful to deal with interregional/international challenges such as in the case of the EUSDR, due to the exploitation of regional diversity while avoiding duplication of resources, as well as achieving a critical mass needed to tackle major common challenges.

Box 2 – J'innove in Nord-Pas de Calais



J'innove is a partnership group that supports and promotes innovation throughout the region. In collaboration with other structures, such as universities, clusters, Chamber of commerce, it provides specialized services for SMEs in the fields of training, research commercialization and innovative company creation.

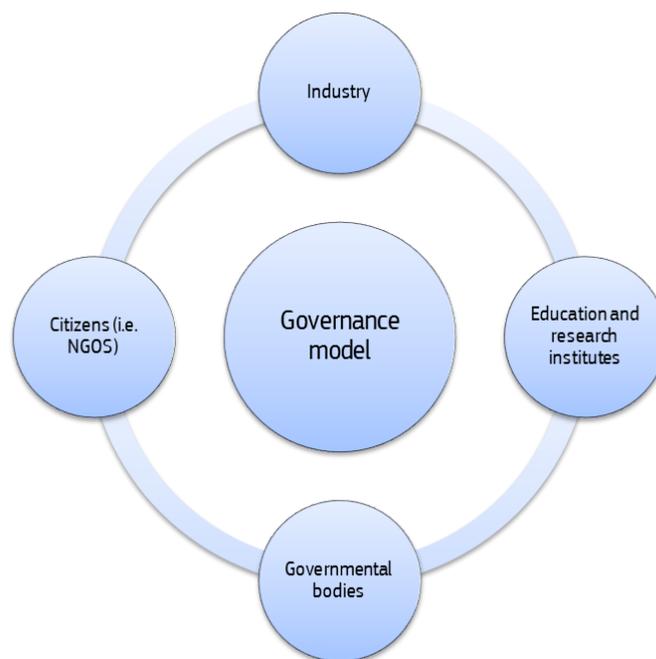
Furthermore, the network has developed several tools and initiatives such as:

- Astride online platform: for mapping regional innovation actors, communication and decision-making among its members
- Innoscope methodology: for assessing innovative potential of SMEs by a range of indicators
- Summer University networking event: for regional and cross-regional stakeholders.

Step 2 – Set up a sound and inclusive governance structure

During the design and implementation of Smart Specialisation Strategies it is recommended the participation of industry, education and research institutes, government (at different levels) and groups representing demand-side perspectives, such as organizations representing consumers, citizens and/or workers (Figure 3). This structure follows the logic of the quadruple helix model of innovation which recognizes the important contribution of society in the innovation process.

Figure 3 - The quadruple helix model of innovation



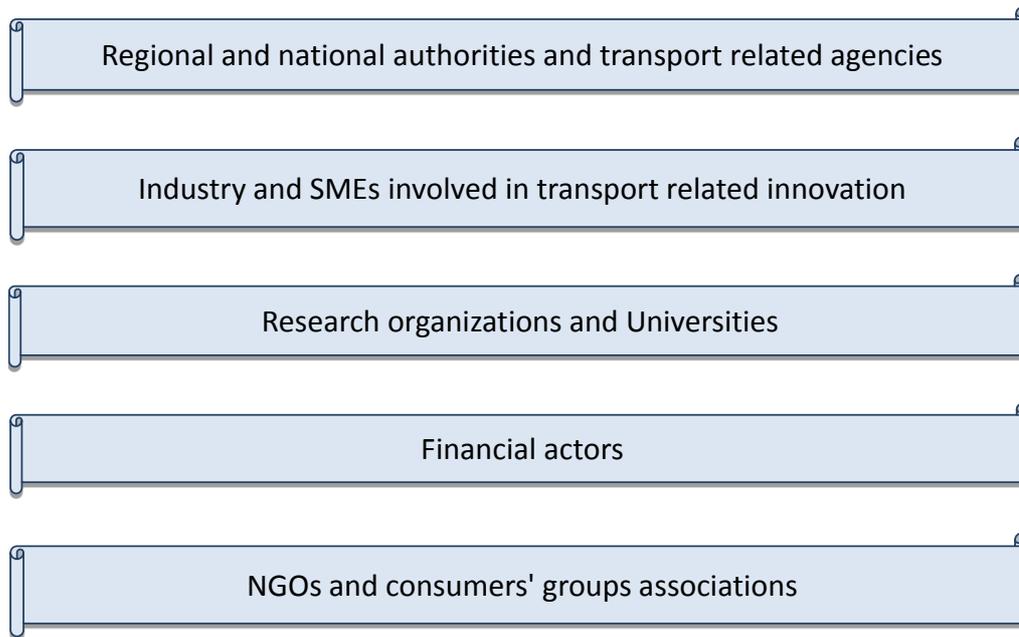
Source: Own elaboration

However this structure may be challenging for managing authorities, because such diverse group of actors may raise potential conflicts that could slow down the entire process. For that reason it is recommended that experts with interdisciplinary knowledge and experience in interaction with different actors, moderate the design phase of the strategy. The RIS3 guide recommends the use of collaborative leadership, which means that different stakeholders should collaborate and every actor is given the lead in a certain stage of the strategy definition process. Special attention should also be paid to powerful groups (i.e. lobbies), preventing their interests prevailing in the setting of priorities.

Participants of the strategy should represent different levels of governance, from global to local perspectives, which might add coordination difficulties to consensus building towards a shared vision. However, the co-existence of different governance levels guarantee that regional priorities are aligned with more global objectives (see step 4) while matching regional with national strategies for research and innovation, which in turn will constitute the backbone of operational programmes.

For transport, a list of potential stakeholders is presented in Figure 4, however the exact structure will vary from region to region, depending on the regional context (i.e. the level of regional autonomy).

Figure 4 – List of potential transport stakeholders



Source: Own elaboration

Step 3 – Elaboration of an overall vision for the future of the region

Achieving a shared vision requires the attraction of regional stakeholders around a common strategic direction towards boosting the economic development of the region and positioning it on the international context. This solid and realistic project should be ambitious but still credible.

All stakeholders should agree on a comprehensive scenario for the development of the regional economy, society and environment. This scenario constitutes the first step to define a share vision on the regional future prospects, defining what the main goals are and why they are important. In this sense it is important that the vision meets societal challenges such as those identified in the Europe 2020 strategy⁹. Regional scenarios will include different measures to develop the regional assets and this will depend on the type of region (see an example in Box 3).

⁹ http://ec.europa.eu/europe2020/index_en.htm

Box 3 - Poitou-Charentes vision



The region developed a joint vision for Eco-mobility, as an industry with strong potential to reduce the environmental impact of transport and empowering regional key actors (world players and SMEs) related with energy storage, batteries and electrical vehicles.

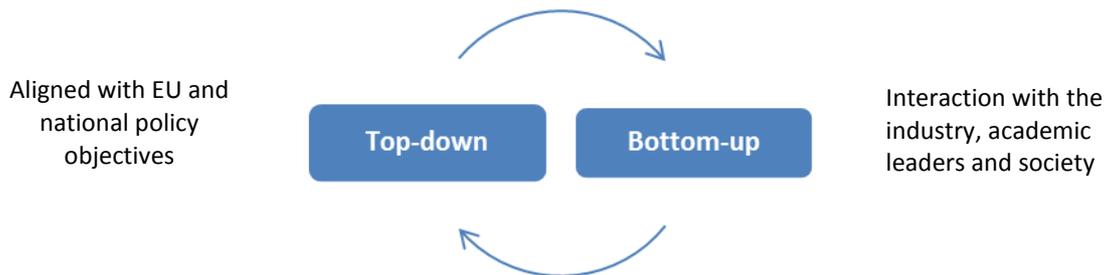
One of the main contributions from the regional government was the establishment of a local public enterprise 'Poitou-Charentes Auto-Partage' providing a service called Régionlib, which is a public system of car-sharing for electric vehicles.



Sept 4 – Identification of priorities

For the identification of priorities a mix of two approaches are suggested: a top-down approach and a bottom-up approach (Figure 5). A top-down approach means that priorities should be aligned with EU and national policy objectives, while a bottom-up approach ensures that priorities are set through the interaction with entrepreneurs, the business community (including SMEs), leading academics and groups of citizens that will help in the definition of existing areas of specialisation and future prospects.

Figure 5 – Interactive process for the identification of priorities



Source: Own elaboration

A limited number of priorities need to be selected according to regional capabilities and their potential for smart specialization. Priorities can be focused on specific technological or sectorial developments but also at the horizontal level, as well as social and organizational innovations. Finally priorities should be steered towards the achievement of societal challenges.

Figure 6 presents the transport innovation fields proposed in the Strategic Transport Technology Plan (STTP), a document jointly elaborated by the European Commission and experts from academia and the industry side. These technology fields are regarded as crucial for the future competitiveness of the European transport sector and for the achievement of the White Paper's¹⁰ goals.

The STTP provides for each technological field, important information about key relevant technologies, stakeholders, barriers, regulation, governance, policies and other pressing issues, as well as about tools such as cooperation platforms, partnerships, initiatives, legislation and directives relevant to each field.

¹⁰The White Paper (European Commission, 2011a) is the main policy document in transport elaborated by the European Commission.

Figure 6 – Transport innovation fields presented by the STTP

Research and innovation area	Field	The ten White Paper goals (summarised for readability)									
		Low-emission city transport and logistics	Low-carbon fuels in aviation and maritime transport	Freight; modal shift from road transport	EU-wide high-speed rail network	Multimodal TEN-T core network	Long-term comprehensive network	Traffic-management systems in all modes	Multimodal transport information	Close to zero fatalities in road transport	Towards 'user pays' and 'polluter pays'
Clean, efficient, safe, quiet and smart transport means	<i>Clean, efficient, safe, quiet and smart road vehicles</i>	■								■	
	<i>Clean, efficient, safe, quiet and smart aircraft</i>		■				■				
	<i>Clean, efficient, safe, quiet and smart vessels</i>		■	■							
	<i>Clean, efficient, safe, quiet and smart rail vehicles</i>			■	■						
Infrastructure and smart systems	<i>Smart, green, low-maintenance and climate-resilient infrastructure</i>			■	■	■				■	
	<i>Europe-wide alternative fuel distribution infrastructures</i>	■	■	■							
	<i>Efficient modal traffic-management systems (incl. capacity and demand management)</i>		■	■	■	■	■	■	■	■	
Transport services and operations for passengers and freight	<i>Integrated cross-modal information and management services</i>		■	■		■	■		■		
	<i>Seamless logistics</i>	■	■	■					■		
	<i>Integrated and innovative urban mobility and transport</i>	■						■	■		

■ Major contribution anticipated from this priority field to reach the White Paper's goal
 ■ Some contribution anticipated from this priority field to reach the White Paper's goal

Source: European Commission (2012a)

Step 5 – Definition of coherent policy mix, roadmaps and action plan

An action plan needs to be prepared for the implementation of the strategy. This would detail the rules and tools regions will need, to reach the defined priorities. It will also provide information about the strategic objectives, timeframes for implementation, identification of funding sources and tentative budget allocation. The RIS3 guide recommends that a multi-annual Action Plan should include:

- Definition of the broad action lines corresponding to the prioritised areas and the challenges faced within these areas
- Definition of delivery mechanisms and projects
- Definition of target groups
- Definition of actors involved and their responsibilities
- Definition of measurable targets to assess both results and impacts of actions
- Definition of timeframes
- Indication of funding sources, targeted to several groups and projects

Each region needs to evaluate funding sources that might be available for developing the strategy and this includes, European, national, regional and/or private funds. Synergies between funds are essential to increase regional competitiveness and maximise the impact and efficiency of public funding. The European Commission (European Commission, 2014c) has recently launched a guide on synergies between ESIF, Horizon 2020 and other research, innovation and competitiveness-related Union programmes, such as COSME, Erasmus+, Creative Europe, European Union Programme for Employment and Social Innovation and digital services part of the Connecting Europe Facility.

The RIS3 offers the possibility to combine Horizon 2020 and the ESIF in the same project for the first time. For transport synergies between EISF and Horizon 2020 can be explored, within activities funded under the "Smart, Green and Integrated transport" Challenge of Horizon 2020. Table 2 below presents some opportunities for synergies in the transport field between Horizon2020 and Cohesion policy thematic priorities.

Box 4 presents some examples of successful ERDF funded projects supporting transport innovations.

Table 2 – Opportunities for synergies between Horizon 2020 and Cohesion policy

Cohesion policy thematic priorities	Opportunities for synergies with Horizon 2020
1. Strengthening research, technological development and innovation	Regional projects (funded with Cohesion Policy funds) that help building research and innovation capacity. Transport research and innovation infrastructure that facilitates participation in Horizon 2020 and crystallises economic growth, e.g. technology parks, incubators, firm cooperation, excellence centres, etc.
2. Enhancing access to, and use and quality of, information and communication technologies (ICT)	ICT tools for better mobility and transport schemes - deployment of EU funded research projects results into market applications at European, national and local levels Use of ICT infrastructure for transport simulation
3. Enhancing the competitiveness of small and medium-sized enterprises, the agricultural sector and the fisheries and aquaculture sector	Support to SME in the area of transport
4. Supporting the shift towards a low-carbon economy in all sectors	Regional deployment of production centres for alternative fuels for transport Regional demonstration of low-carbon vehicles Regional deployment of recharging infrastructure for low-carbon vehicles Regional actions for the promotion of low-carbon mobility patterns - social marketing
5. Promoting climate change adaptation, risk prevention and management	Specific research activities exploring or deploying solutions for climate change adaptation and resilience of transport infrastructure
6. Protecting the environment and promoting resource efficiency	Large scale regional testing of transport technologies that reduce resource consumption Transport products recyclability projects and activities
7. Promoting sustainable transport and removing bottlenecks in key network infrastructure	Solutions for multimodal and intermodal transportation of persons and freight, from one case project to European deployment Transport infrastructure Deployment, at regional level, of emerging transport technologies, for instance, advanced ITS
8. Promoting employment and supporting labour mobility	Activities for the promotion of transport-related jobs, including training
9. Promoting social inclusion and combating poverty	Regional projects increasing transport accessibility and affordability that are scalable at European level or that are continuation of previous Horizon 2020 actions

10. Investing in education, skills and lifelong learning	Activities for the promotion of all types of education and training in the field of transport. In particular, training/ educational programmes for sustainable mobility/behaviour
11. Institutional capacity and efficient public administration	Support to regional transport administrations

Source: European Commission (2013a)

Box 4 – Successful projects funded by ERDF in the area of transport innovations

The National Renewable Energies Centre (Navarre, Spain)



Built with the support of ERDF, the centre is equipped with ultra-modern technologies to conduct advanced R&D activities related with renewable energies in 5 specific fields: wind power; solar energy (thermal and photovoltaic); biomass energy; bioclimatic architecture; electronics and power electronics and the use of hydrogen for energy storage.

It has generated positive impacts in the local community and has acquired a solid reputation both nationally and internationally

ROADEX network (FI, SE, UK, Faroe Islands, Greenland, Norway)

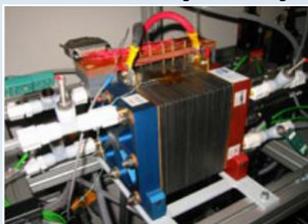


ROADEX is a scientific network that promotes cooperation between northernmost regions of Finland, Scotland, Norway, Sweden and also Greenland, Iceland and the Faroe Islands.

Common research projects are conducted by engineers of these countries on the reliability and maintenance of roads in harsh climate and poor ground conditions.

Results were disseminated through pilot projects, a website, practical guides, seminars and e-learning trainings. Partners have seen direct benefits in improved road survey systems, drainage analysis, risk assessment, examination of health issues and socio-economic considerations

Fuel Cell Test Platform (Belfort, France)



The ERDF has jointly funded the installation of a platform in Belfort which makes it possible to test the integration of fuel cells in land transport.

This centre is accessible for both industrial and academic customers in this field. With this centre the region of Franche-Comté aims to play a major role in the fuel cells emerging sector.

PSA, Faurecia and GEEPE (General Electric), as well as national and international players (Renault, Delphi, etc.) are working with the platform. Partners have seen direct benefits in improved road survey systems, drainage analysis, risk assessment, examination of health issues and socio-economic considerations.

Step 6 – Integration of monitoring and evaluation mechanisms

Establishing monitoring and evaluation procedures should be established at the very beginning of the strategy. While monitoring refers to following the implementation of the strategy, evaluation procedures will assess the outputs of the strategy and whether specific objectives have been met. For that purpose it is important that objectives are clearly specified and measured together with the specific target(s) attached to all of them. The European Commission promoted a guide on evaluation of innovation activities for different types of ERDF co-funded measures (TECHNOPOLIS GROUP & MIOIR, 2012). Also in this context the RIS3 guide refers to 3 types of indicators for the monitoring and evaluation system:

- *Context indicators*, attached to the overall objectives of the strategy that will score the region against the average score of its Member States or other similar regions (see Table 3 for some examples).
- *Result indicators*, analyse contribution to the overall strategic goals by each component of the strategy (some examples can be found in Table 4).
- *Output/Outcome indicators*, measure the progress of the action undertaken in order to achieve the expected results (see Table 5)

Table 3 – Example of context indicators

CONTEXT INDICATORS
R&D Intensity (% of total internal costs in R&D compared with regional GDP)
Ratio between private and public funded R&D
Share of employment in R&D activities in total employment (%)
Scientific publications from public funded projects which are in the 1st most cited quartile of their own scientific area (%)
Scientific publications with international collaboration (%)
Innovation intensity of firms
Innovative firms (%)
Share of firms with technological innovations (%)
Share of firms with non-technological innovations (%)
Increase in the number of patents
Index of regional competitiveness
Increase of risk capital invested

Source: Own elaboration

Thus monitoring aims at verifying that activities are planned, funds are correctly delivered and that result indicators evolve in the desired direction. Evaluation on the other hand, aims to assess the impacts of the actions undertaken (i.e. their contribution to the observed change as measured by the result indicators) and to understand why and how the impacts are being achieved. For that purpose it is

important that objectives are clearly specified and measurable together with specific target(s) attached to all of them - targets can be short, medium or long-term.

In order to assess change, indicators should have a baseline (the situation before the intervention) and their values will need to be monitored all along the process. Result indicators should measure their change towards higher competitiveness and greater added value.

Table 4 – Examples of result indicators

Initiative	Result indicator
Improve the knowledge base	<ul style="list-style-type: none"> • Scientific publications • Patents • Prototypes developed • Industrial PhD awarded • Attraction and retention of scientific personal
Support new innovative firms	<ul style="list-style-type: none"> • New innovative firms created • New products or services launched • New or up-graded production lines • Funding agreements • Growth in turnover and employment of supported firms
Support the internationalization of firms	<ul style="list-style-type: none"> • Increase of employed scientists/engineers • Increased of on-line sales • Increase of exports
Integration of local firms in global value chains	<ul style="list-style-type: none"> • Number of international R&D projects • Increase in exports and exporting companies • Increased collaboration between (regional, national, international) firms and research institutions
Support scientific and technological networks	<ul style="list-style-type: none"> • Number of firms engaged in such networks • Enhanced capacity to jointly develop products and services • Increased R&D cooperation between enterprises and research institutions • Newly established and extended networks and centres
Support innovation on green transport means	<ul style="list-style-type: none"> • GHG emissions reduced • CO2 emissions reduced • Change in the share of renewables consumed by transport • Change in the share of green vehicles

Source: Own elaboration

The sources of information for these indicators would ideally come from the monitoring process, official databases, ad hoc surveys, peer reviews and more rarely from regional or national statistics. Some regions have implemented innovative tools to provide fact-driven decision-making (see Box 5).

This process should also be understood as dynamic, in the sense that certain characteristics of the strategy can be modified, if particular changes are identified in the economic conditions or due to new evidences during the implementation phase. One important source of information while validating the monitoring and evaluation process is peer review meetings, made available by the RIS3 platform. Other regions, already engaged in RIS3, provide their comments on the region under review while sharing their experience on the implementation of their own strategies. This way, regions learn from each other and find potential partners for collaboration.

Table 5 – Examples of output indicators

Action	Output indicator
Grants and financial instruments	<ul style="list-style-type: none"> • Number of funded projects • Number of participant entities • Increased R&D investment leveraged by funded projects • Acquisition of new technology
Investment in research infrastructure	<ul style="list-style-type: none"> • Number of funded infrastructure • Installed equipment and instruments • Doctoral and post-graduate training delivered
Support to incubators, start-ups, spin offs, seed capital, business angels, etc.	<ul style="list-style-type: none"> • Newly built or renovated buildings and equipped labs • Fully equipped incubators • Services delivered to tenants • Number of new technological initiatives • Innovative firms supported
Matching the graduate skills with business needs	<ul style="list-style-type: none"> • Number of degrees designed in collaboration with firms or other institutions • Number of scientists and engineers working on joint projects
Support for the employment of scientist , engineers and innovation administrators	<ul style="list-style-type: none"> • Number scientist , engineers and innovation administrators hired
Support services for accessing to international R&D funding	<ul style="list-style-type: none"> • Number of dissemination actions undertaken • Number of counselling services provided

Source: Own elaboration

Box 5 - The regional innovation observatory of Provence-Alpes-Côte d'Azur region



This observatory was created in the context of the Regional Innovation Strategy to support fact-driven decision-making process. It collects, organizes and analyses innovation related data.

The observatory has proved its usefulness for the RIS3 design and implementation, mainly through four kinds of publications:

- The regional innovation index: gives an overall picture of the regional innovation context, with a benchmark to other French and European comparable regions.
- The regional SME innovation barometer: survey among regional SMEs to understand SME profiles and support service needs in carrying on their innovation activities.
- The RIS monitoring: a scoreboard that monitors the strategy implementation and the results produced in the middle-long term.
- One shot studies: focusing on specific innovation policy issues (i.e. incubators; industrial spin off).

Part 2 - Developing transport innovation strategies

Part 2 - Developing transport innovation strategies

The main aim of this chapter is to associate specific technological fields with Smart Specialisation Strategies (RIS3) following the example of the Digital Agenda Toolbox (European Commission, 2014a). Ten critical transport areas for transport were selected based on the Strategic Transport Technology Plan (STTP) (European Commission, 2012a).

The STTP can be considered as the research and innovation complement of the transport White Paper. Aiming to assist in directing funding and financing, it identifies the main priority fields and addresses issues such as innovation efficiency and deployment limitations.

In

Figure 6 we have presented the ten transport technological fields, which can be aggregated into three broad innovation areas: clean, efficient, safe quiet and smart transport means; infrastructure and smart systems; and transport services and operations for passenger and freight. These fields are expected to have a great contribution to the future competitiveness of the European transport sector as well as being determinant for the achievement of the White Paper goals.

In the following sections roadmaps for including the ten transport innovation fields into RIS3 are presented.

Clean, efficient, safe and smart road vehicles

Why invest in Clean, efficient, safe, quiet, smart road vehicles?

Innovation in the field of road transport will be crucial for the achievement of objectives laid down in the Europe2020 Strategy, particularly regarding climate change and energy sustainability. Road transport accounts for the largest share of transport related GHG emissions (71.9% in 2012, according to the Statistical pocketbook (European Commission, 2014b)). Innovation will also be needed to comply with tighter emission standards that are expected in the future. According to the White Paper (European Commission, 2011a) CO₂ emission standards are expected to become equal to 20g CO₂/km for cars and 55g CO₂/km for light commercial vehicles by 2050.

On the other hand, fuel efficiency has a high potential to improve in road transport. Experts point towards a 40% efficiency improvement in long-distance freight transport and 80% efficiency improvement in urban passenger transport by 2030 (ERTRAC, 2010). Overall vehicle efficiency is expected from further improvements in engine design, alternative fuel propulsion systems, lightweight materials, wasted energy recovery, system optimisation, future drive train concepts and new infrastructure systems.

Furthermore, fatalities and severe injuries are expected to be reduced by 60% by 2030 (ERTRAC, 2010), mostly from the use of Intelligent Transport Systems (ITS) such as communication technologies that will enable exchange of information between vehicles and road infrastructure. These exchanges may be of three kinds: infrastructure-to-infrastructure (I2I), vehicle-to-infrastructure (V2I) and vehicle-to-vehicle (V2V).

Barriers and challenges

Some barriers refer to the implementation of the strategy itself, for example regarding the identification of economic niches and competitive advantages during the development and definition of deployment activities to be carried out. Further challenges include the mobilization of all necessary actors involved in the regional innovation system and promotion of cooperation in terms of R&I, particularly by attracting investment, encouraging entrepreneurship and attracting new users.

Other barriers have to do with the technical aspects of this particular innovation field. Electromobility is a big bet in the automotive sector, but it requires further developments in order to improve performance and economic efficiency, hence to be able to compete with internal combustion engines. The availability of infrastructure for electric vehicle (EV) is also seen as a bottleneck for its widespread diffusion. But uncertainty about winning technologies is high, in this sense standards are needed for recharging infrastructure, vehicle-to-grid communication and billing. Furthermore standards for health and safety related aspects, such as electromagnetic interference, user protection and emergency handling need to be revised (European Commission, 2012b).

The main barriers and challenges for ITS applications on safety systems are related with the deployment of already existing innovations in this area. The deployment of ITS technologies would require new standards, a more robust understanding of driver behaviour, raising user awareness to stimulate demand, appropriate policy frameworks and incentives for more investment in road-safety –related systems and services.

Competition from developing countries is exerting cost-cutting pressures in the automotive industry. Furthermore, the shift towards a low carbon economy and the increasing safety concerns, have given place to more legislation that has a strong influence on the number and type of vehicles to be produced. The industry is challenged to comply with those pressures while remaining competitive globally.

How to act?

Analysis

The region should analyse its innovation capabilities in the field of '*Clean, efficient, safe, quiet and smart road vehicles*'. This includes identifying the main stakeholders in the region, such as companies, universities, research institutes, end-user groups, competence centres and examining their innovation activities. Then completion of a SWOT analysis of their capabilities, skills and their competitive advantages should highlight the innovation potential of this innovation field in the region as well as regional stakeholder needs for policy support (i.e. services, infrastructure, financing instruments, etc.)

Governance/Stakeholder involvement

The development of RIS3 should engage different stakeholders involved in this innovation field. Some examples are:

- Public sector, such as national/regional ministries in charge of road transport, energy and health. Public authorities could engage with specialized boards such as:
 - European Council for Automotive Research and Development (EUCAR) representing the main European passenger car and commercial vehicle manufacturers
 - European Automotive Research Partners Association (EARPA); an association of independent R&D companies, research institutes and universities in the automotive sector.
 - IMobility Forum: this is a 3-year support action that fosters the deployment of intelligent mobility in Europe by organizing the iMobility Forum activities, including stakeholder networking, deployment support, awareness raising and dissemination of results of ICT for smart, safe and clean mobility.
 - The European Technology Platform on European Road Transport Research Advisory Council (ERTRAC): a technology platform which brings together relevant stakeholders in the field of road transport

- ERTICO –ITS European Commission: a partnership of companies and institutions involved in the production of Intelligent Transport Systems (ITS)
- Fuel cells and hydrogen joint undertaking (FCH) is a public private partnership (PPP) between the European Commission, European industry and research organisations to accelerate the development and deployment of fuel cell and hydrogen technologies/
- Industry, such as automotive manufacturers and suppliers, firms working in the field of energy, ICT, smart grids and road infrastructure
- Centres of knowledge creation and diffusion, such as universities (i.e. transport departments), research centres, technological centres, other institutions (i.e. economic clusters)
- Investors
- NGOs

Priority setting

Selecting the priority areas where to focus innovation efforts is a controversial task that includes sorting out the dominant innovation capabilities existent in the region, both in terms of critical mass and future competitiveness. Common applications relevant to the field 'Clean, efficient, safe, quiet and smart road vehicles' include the following: ICE, biofuels, electromobility, multifuel engines, lightweight materials, aerodynamic designs, new vehicle concepts (autonomous vehicles), V2X.

Priorities should be set with the endorsement of regional stakeholders and be aligned with broader policy objectives laid down by national and European governments. Regarding the goals in the transport White Paper (European Commission, 2011a) the following objectives are relevant for this innovation field: low-emission city transport and logistics and close to zero fatalities in road. Prioritized actions should have the highest possible potential impact in terms of these policy goals. On the other hand, priorities should meet the innovation needs of regional stakeholders in terms of infrastructure, services, financing or skills.

Policy mix

Possible action lines may include:

- Financing of research infrastructure devoted to 'Clean, efficient, safe, quiet and smart road vehicles'.
- Promoting interregional networks of stakeholders working in this innovation field.
- Supporting regional clusters that will promote R&I investments in this field.
- Services for innovative SMEs working in this field.
- Promoting manufacturing platforms and pilot production *lines* for 'Clean, efficient, safe, quiet and smart road vehicles'.
- Funding infrastructure for testing and certification of important components and systems of this innovation field.
- Funding of large scale deployment actions and public procurement schemes (i.e. infrastructure for EV; low carbon transportation systems).
- Enhancing the cooperation between universities, research institutes and industry in order to improve labour skills in the field of 'Clean, efficient, safe, quiet and smart road vehicles'

In the context of RIS3, potential funding synergies between EISF and other sources of funds need to be explored. At the European level, possible funding lines for the 'Clean, efficient, safe, quiet and smart road vehicles' innovation field include the following:

- Horizon 2020: which funds research in the automotive sector, mainly focusing on clean, efficient, safe and smart vehicles, including a specific call for 'Green Vehicles'.
- European Green Vehicles Initiative: a PPP dedicated to the promotion of research, development and demonstration of green vehicles and mobility system solutions. It funds projects particularly in the fields of energy efficiency of vehicles and alternative powertrains.
- CIVITAS, and initiative that supports the implementation and test of innovative and integrated strategies in energy, transport and environmental issues. Over 60 European metropolitan areas have benefited from this support, in different technological fields such as ticketing systems, clean bus fleet or waterborne goods transport.
- Factories of the Future: a PPP that aims to help EU companies to achieve global competitiveness, focusing on increasing the technological basis through the development and integration of Key Enabling Technologies (KET). The PPP is co-financed by Horizon 2020, but it has its own R&D objectives and launches its own annual calls
- Connecting Europe Facility: especially under the objectives of 'Supporting sustainable and efficient transport systems'.
- COSME: is an EU programme for the Competitiveness of Enterprises and Small and Medium-size Enterprises. Support is offered through the following schemes:
 - Financing SMEs through loan guarantees and counter-guarantees, venture capital and mezzanine finance to expansion and growth-stage SMEs.
 - Access to markets offering different services such as information on EU legislation and programmes, assistance to find a business partner abroad, advice on access to EU finance, innovation and technological transfer support.
 - Supporting entrepreneurs through education, improving the business environment, special support is given to specific groups such as young people, women or senior entrepreneurs.
 - Promoting better conditions for business creation and growth through the reduction of administrative and regulatory burden and the exchange of best practices on SMEs policy.

Box 6 - Laboratory of reactivity and chemistry of solids (France)



The laboratory hosts a project related to transport of the future. It looks for innovative solutions to provide electricity for "onboard energy" vehicles.

ERDF supported the purchase of high-tech equipment for studying batteries and nanomaterials. Important advances have been made in the field of new generation of lithium-ion batteries that will improve the storing electricity of vehicles, which has become a crucial matter for the competitiveness of European car manufacturers.

Clean, efficient, safe, quiet and smart aircrafts

Why invest in Clean, efficient, safe, quiet, smart air vehicles?

In 2012, air transport represented the second transport mode in terms of passenger modal share in the EU 28 and also the second in terms of energy consumption (12%). Considering emissions, civil aviation represents the third largest mode, with a share of 12.8% of the total GHG emissions from transport. (European Commission, 2014b)

The aeronautics sector has an important economic weight for the EU. According to the Aerospace and Defence Industries Association of Europe (ASD, 2014), the aeronautics sector had €138.4 billion turnover in 2013 and invested €16 billion in R&D, which represents an R&D intensity of 11.6%. The sector generates high levels of employment in Europe and especially of skilled labour, as 38% of the labour force possesses a university degree.

Aeronautical innovations have a high potential for diversification, since they involve other economic and technological sectors, thus contributing to the growth of the whole economy. Furthermore innovation in this sector will be determinant for dealing with the challenges marked in the Europe 2020 agenda and transport White Paper (European Commission, 2011a). Big efforts have been made by the industry to reduce fuel consumption and emissions, while fuel consumption in the aviation sector is expected to decrease substantially in the future. According to the STTP (European Commission, 2012b), fuel consumption in this sector has the potential to be reduced by 50% in 2020, compared with 2000 levels, while aviation emissions can be reduced by 50% in 2050. Furthermore, the share of low-carbon sustainable fuels in aviation could reach 40% in 2050 (European Commission, 2011a).

Carbon emissions as well as noise and other emissions (e.g. NO_x) have an adverse effect on the environment and health. The High level Group on Aviation Research, in the 'Flightpath 2050' report (European Commission, 2011d) assumes that new technologies should allow a 75% reduction of CO₂ emissions per passenger km and a 90% reduction in NO_x emissions by 2050. Noise emissions are also expected to be reduced by 65% (all relative to 2000).

Regarding safety, the 'Flightpath 2050' report assumes that accidents will be less than 1 to ten million commercial aircraft flights in 2050, while natural hazards will be properly predicted and mitigated. Innovation will also allow air transport systems to accommodate manned and unmanned air vehicles in a seamless and secure way, as well as the provision of seamless and high security in boarding and security checks, ensuring the resilience of air vehicles and transport system.

Although incremental innovations have dominated recent aeronautical research, a next generation of aircraft is being developed thanks to automation and high technology. ICT technologies will play an important role in improving the information channels of air services and operations and will promote seamless mobility by improving the resilience of transport system operations by means of advanced air traffic management systems.

Barriers and challenges

Innovation in aircraft manufacture is very expensive due to long life cycle in aeronautics (aircrafts operate around 30 years). Therefore public support to innovation is very important for the competitiveness of the European aviation industry. For this reason this sector receives a share of public R&D above all other transport sectors. According to ASD (2014) one third of total R&D in aeronautics was financed by governments.

On the other hand, certification is extremely costly in the aeronautic sector. The whole process should be reviewed in order to decrease costs, increase efficiencies thereby allowing a better uptake of new technologies. According to the 'Flightpath 2050' report (European Commission, 2011d), a 50% reduction

in the cost of certification should be possible and new generation standards should be created to improve the competitiveness of the sector.

European players are facing fierce competition from rivals in the US, but also from emerging countries such as Brazil, China or Russia. Increasing the level of technology investment will be needed, in order to maintain the competitiveness of European companies. Examples relevant to the facilitation of the uptake of innovations that take place in this sector may come from the field of low-carbon fuels for aviation, noise reduction of air traffic operations and safety.

How to act?

Analysis

During the analysis of regional innovation potential actors involved in the innovation system for clean, efficient, safe, quiet and smart aircrafts need to be identified, while their innovation dynamics inside the region and in the global supply chain need to be analysed.

The final aim of this analytical stage should be to understand the needs of regional entrepreneurs in terms of services and infrastructure. For this reason it is necessary to investigate the sources of public and private financing of innovation and determine the skills to push regional innovation forward.

Interaction with entrepreneurs will be determinant to obtain the above mentioned information. Tools such as rounds of interviews with entrepreneurs, clusters associations and academia could be most useful.

Box 7 - The Andalusian aerospace cluster (OECD, 2013)



- The cluster includes 80 SMEs and 40 non SMEs employing approximately 11 000 people.
- It has a turnover of 2 billion euros amount that represents around 35% of the industrial GDP of the provinces of Seville and Cadiz.
- The cluster benefits from the knowledge base of several universities and research institutes located in the region of Andalusia and has many international linkages.
- The cluster is organised by the Hélice foundation (<http://www.helicecluster.com/>), member of the European Aerospace Clusters Partnership.
- Important aircraft programmes include: A400M, A380 and A350

Governance/Stakeholder involvement

Several stakeholders may be involved in the innovation system of aeronautics, such as the following:

- Air navigation service providers or air traffic control
- Air passengers
- Airspace users, such as airlines, charter companies, air freight providers
- Human resources working in the air transport services, such as controllers, pilots, engineers
- Airport operators
- Regulators and public administration from all geographical scales (regional, national and European)
- Scientific community
- Suppliers, such as ground and aerospace manufacturing; aircraft manufacturers; airborne equipment manufacturers.
- Stakeholders from other transport modes and relevant technology sectors (i.e. energy)

It is also important that public authorities engage with supranational institutions that are active in the field of aeronautical innovation, such as

- Advisory Council for Aeronautics Research in Europe (ACARE), is an European technology platform in the aeronautic and air transport fields, which develops and maintains a Strategic Research Agenda (SRA) which support the establishment of new research programmes in Europe and at national/regional levels.
- Aerospace and Defence Industry Association for Europe (ASD Europe), represents the aeronautics, space, defence and security industries in Europe by raising awareness and promoting the values and positions of its members to EU institutions
- Clean Sky - 2 Joint Technology Initiative is a PPP between the European Commission and the industry. It delivers demonstrators in all segments of civil air transport.
- SESAR - Joint Undertaking was created by the European Union and Eurocontrol in order to ensure the modernisation of the European air traffic management system.

Priority setting

Priority setting for promoting innovation in the field of clean, efficient, safe, quiet and smart aircrafts should be aligned with the broader objectives set in the main policy documents proposed by national and European bodies. Particularly at the European level, the following goals have been 'set by the European Commission:

- Reduction of air fuel consumption by 50% in 2020, compared with 2000 levels (European Commission, 2012b)
- A general reduction of air transport emissions by 50% in 2050 (STTP European Commission, 2012b). In the 'Flight path 2050' report (European Commission, 2011d), the High level Group on Aviation Research sets ambitious targets for a reduction of CO₂ (-75%), NO_x (-90%) and noise emission (-65%, all relative to 2000).
- 40% increase of low-carbon sustainable fuels used in air transport by 2050 (European Commission, 2011a)

Other goals relevant to the competitiveness of the sector that are indicated in 'Flightpath 2050' are the following:

- Better prediction of and reaction to extreme weather events and other hazards.
- New modern design and testing techniques for cost-effective certification in aeronautics.
- New automation technologies that improve safety levels.

Policy mix

Achieving the selected priorities requires that simple and effective mechanisms are accepted by all stakeholders, in order to enable co-ordination of shared objectives for innovative projects. Furthermore, selected actions should reduce the time it takes from initial research to commercialization, as well as the promotion of careers that closely match the needs of the aviation industry.

Regions should seek innovation-related funding and financing instruments. Synergies between ESIF and other sources of funds should be explored. Relevant opportunities could be found in:

- Horizon 2020, under the call 'Mobility for Growth' there is a specific section devoted to research activities in 'Aviation'
- SESAR Joint Undertaking. This initiative coordinates and concentrates all relevant European research and development efforts in the field of ATM, funding important exploratory research and demonstration projects.
- Clean Sky 2 Joint Undertaking: It is responsible of coordinating and funding research and innovation in green aeronautical technologies, through regular call for proposals.
- Connecting Europe Facility: especially under the objectives defined for the transport sector.

Clean, efficient, safe, quiet and smart rail vehicles

Why invest in *Clean, efficient, safe, quiet, smart rail vehicles*?

As a passenger transport mode, rail is the fourth mode in preferences – 6.5% of modal share in 2012 – after air, buses and cars. As a freight transport mode, rail is the third largest mode (10.8% of tonne/km in 2012), after road and sea. In 2011, rail companies in Europe had a turnover of around €78 billion (European Commission, 2014b).

Despite these rather modest figures, the rail sector has received great political attention from the European Commission. According to the White Paper (European Commission, 2011a), by 2050 a 50% shift of medium distance intercity passenger and freight journeys should be achieved from road to rail and waterborne transport. In the same document, the European Commission states that a complete European high-speed rail network should be in place by 2050, which together with a dense railway network in all Member States will enable the majority of medium-distance passengers to commute by rail. Achieving these goals in the rail sector is essential for reaching the 60% GHG emission reduction target and improving the mobility of European citizens. In fact, the rail sector is one of the least polluting modes of transport and the only one that is largely independent of oil as a primary source of energy, as railways run 80% on electricity in Europe (Wiebe, E. et al., 2011). In the EU-28, for 2012, the railways represented 2% of the energy consumption of the transport sector and 0.6% of GHG emissions (European Commission, 2014b).

Current European policies for the rail sector include its integration into seamless transport chains for both passenger and freight services, the development of high speed trains and efficient urban transport systems, and the deployment of several innovations in the field of ICT such as the European Rail Traffic Management System (ERTMS).

Barriers and challenges

Regional innovation strategies in the field of clean, efficient, safe, quiet and smart rail vehicles need to consider the global barriers and challenges of the rail sector so that the region can increase its competitive position globally.

According to the White Paper's aspirations, the European rail system, together with the waterborne sector, will attract the majority share of medium to long distance traffic by 2050, which represents a close to 80% increase of freight volumes (European Commission, 2011b). This will be a great opportunity for the competitiveness of the sector, but will also require specific measures to be taken for managing the increased demand and reduce environmental impacts of the rail sector.

On the technological side, noise and vibrations are considered as major challenges for the European railway system, especially in the most congested networks in Western and Northern Europe and main freight corridors (UIC and UNIFE, 2011). These externalities are expected to increase with traffic. The sector will need to find solutions to mitigate noise and vibrations, at the level of both rail infrastructure and rolling stock. Otherwise, governments may face strong opposition to the expansion of the rail network or to increased levels of rail traffic.

Innovation in the rail sector is associated with big uncertainties that are partly due to the long life cycle of trains (in the range of 30-50 years). During this long term planning innovation process, several trends need to be considered:

- The rise of energy costs, especially in oil prices, may hinder the competitiveness of the sector
- Energy security and independency is a priority linked to the resilience of the railway system. It can be achieved by reducing energy demand and improving efficiency. According to the White Paper it will be possible to improve energy efficiency of trains by 40% in 2050 (compared to 2005 levels)
- Climate change will probably have an impact on emissions standards, challenging the innovation capacity of the rail sector.
- Network disruptions, related with extreme weather events or congestion, may increase in the future due to climate change or increased demand.
- Changing passenger needs and aspirations may force the industry to plan for adaptation of passenger vehicles in order to meet future demand

Furthermore, authorisation and certification in the railway system could be improved, especially regarding efficiency and costs. There is a need for common standards for interoperability, particularly regarding safety certification and equipment authorisations.

Other barriers relate to reaching the target of extending high speed train services, which will require a substantial amount of investment in rail infrastructure. In the context of low economic growth, financing rail infrastructure will be extremely difficult. Additionally, increasing the use of rail will require the creation of a level playing field between modes by supporting new infrastructure connections and new complementarities between modes.

How to act?

Analysis

The current state of the sector needs to be analysed by evaluating industrial players in the region considering characteristics such as employment, value added, turnover, foreign investment, exports, production, innovation capacity, geographical distribution and interaction dynamics (i.e. existence of clusters, cooperation within and between different sectors and institutions). The analysis should also focus on the role of regional industrial players in the global supply chain.

Once the industrial players have been identified, the analysis should focus on existing infrastructure supporting innovation in this sector (i.e. technological parks), as well as the knowledge base existing in the region (i.e. universities, research institutes, technological centres). This evaluation of existing assets should reveal the barriers for innovation faced by regional entrepreneurs and launch a thorough reflection on the entrepreneurs' needs in terms of funding, infrastructure, human resources and skills.

Better industry-public strategy support should be based on this analytical step, aligning public administration policies with industrial technological needs.

Governance/Stakeholder involvement

The success of RIS3 will largely depend on the involvement of stakeholders relevant to clean, efficient, safe, quiet and smart rail vehicles. A list of relevant stakeholders could include:

- Rail operators
- Infrastructure managers
- Freight companies
- Manufacturers and suppliers of railway products
- Research institutes
- National, regional and local governments

- Passenger's associations

The RIS3 should be aligned with the international rail community in order to minimise, as much as possible, administrative and technical barriers to interoperability. The following are some examples of international organizations linked to the railway sector:

- Advancing Public Transport (UITP), represents the interest of worldwide public transport companies, from the fields of urban, local, regional and national mobility.
- Association of the European Rail Industry (UNIFE), represents the European rail manufacturing industry gathering over 80 of Europe's leading large and SMEs companies
- European Rail Infrastructure Managers (EIM), represents the interests of independent European Rail Infrastructure Managers.
- POLIS, is an network of European cities and regions working together to develop technologies and policies for local transport
- European Rail Research Advisory Council (ERRAC), is a technology platform that focus on increasing the innovation and guiding research efforts of the rail sector at the European level. It includes the major European rail stakeholders, which enhance collaborative European rail research and innovation
- International Union of Railways (UIC), aggregating railway companies, infrastructure managers, railway operators from around the world and promoting the rail transport at world level.
- Community of European Railway and infrastructure Companies (CER), formed by European railway undertakings, their national associations and infrastructure companies, with the objective to contribute to a regulatory environment and increase business opportunities for its members.

Priority setting

This step comprises the identification of areas of existing regional strengths, weaknesses and potentials for future development. Surveys and workshops with relevant stakeholders are suitable to obtain this information.

The STTP has identified the following key topics for research and innovation in the rail system:

- Braking technology: to facilitate the operations of longer and heavier trains and reduce noise
- Innovative electric power supply/management and propulsion systems: to reduce energy consumption and improve the use of regenerated energy in the rail system
- New high-strength and light-weight materials: to improve the payload-deadweight ratio in rail traffic and enable new vehicle designs
- Train formation technologies/coupling: automatic central couplers will facilitate the operation of longer and heavier trains, rationalise the train formation process and improve on-board power supply of freight trains.
- Process innovation in servicing and maintaining complex rolling stock and infrastructure that will improve the reliability and productivity and reduce life cycle costs.
- Automation in terminal handling and intermodal loading units. Automated operation of metropolitan railway systems is already in place in many regions and further developments are expected in automated services for train operations.
- Development and better use of information technologies: many innovations in this sector will come from the information technology (IT) side, which is expected to increase traffic management, but also the performance and productivity of the rail sector.

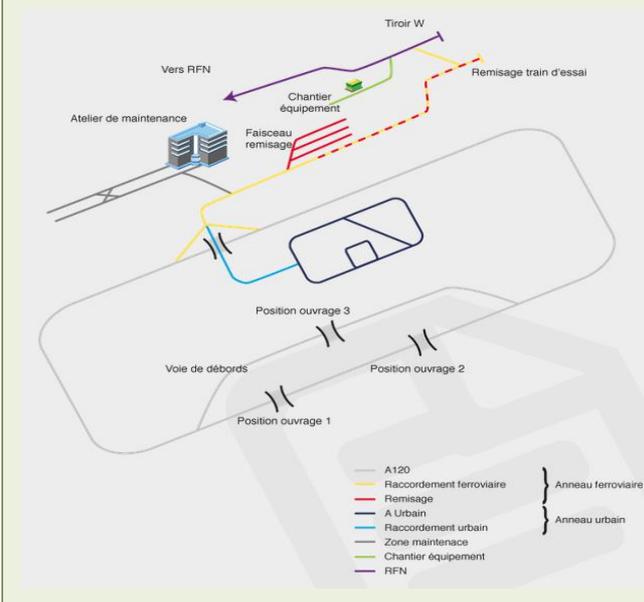
- Security: the improvement of security standards will bring additional benefits for the rail freight (i.e. increase the capacity of transporting damage-sensitive goods) and maintain customer confidence.
- Transshipment technologies: crucial for improving the efficiency of intermodal terminals, also to cope with gauge differences between countries and promote new production methods for intermodal traffic.

Policy mix

Public actions should complement private investments in the field of clean, efficient, safe, quiet and smart rail vehicles. ESIF could be used to finance research in this field, ideally in combination with other sources, such as:

- Horizon 2020. This framework program contains a specific call for the rail sector, under the 'Mobility for Growth' chapter. Particularly importance is devoted to 'New generation of rail vehicles'.
- Connecting Europe Facility
- Marco Polo, co-funds direct modal shift of traffic avoidance projects and projects providing supporting services which enable freight to switch from road to other modes (rail, sea and inland waterways)
- 'Shift2rail – Joint Undertaking'. This is the first European rail joint technology initiative, launched within the Horizon2020 that supports research and innovation and market-driven solutions to complete in the Single European Railway Area. It has its own innovation programmes in the fields of:
 - Cost-efficient and reliable trains, including high capacity and high speed trains
 - Advance traffic management and control systems
 - Cost-efficient, sustainable and reliable high capacity infrastructure
 - IT solutions for attractive railway services
 - Technologies for sustainable and attractive European freight

Box 8 - RAILENIUM – Institute for technological research (Source: <http://www.railenium.eu>)



Located in the French region of Nord-Pas-de-Calais, the Institute develops R&D activities, together with tests and certification in the railway system.

R&D projects are undertaken in cooperation with the scientific community and industry, organized around key topics defined by the Institute.

The test centre develops tests under rigorous and controlled conditions. It can be used to validate technologies, systems and processes related with the management of infrastructure.

Clean, efficient, safe, quiet and smart vessels

Why invest in Clean, efficient, safe, quiet, smart vessels?

Waterborne transport is of very high importance for Europe, especially for freight. It is estimated that around 90% of the EU external freight trade is made over sea while in 2008, 15% of goods' loads and 25% of unloads, globally, took place in Europe (European Commission, 2011c). Furthermore, shifting to waterborne transport is among the main goals of the transport White Paper (European Commission, 2011a); more specifically, a target of 50% shift of road freight over 300 km to other modes including waterborne has been set in order to optimise the performance of multimodal logistic chains and increase the use of more energy-efficient modes. To obtain a better idea of the expected benefits of such a shift, a 45% improvement in energy efficiency for ships by 2050 in comparison to 2005 is assumed in the preferred scenario of the Impact Assessment accompanying the White Paper (European Commission, 2011c), as a result of emission standards.

Although the European shipbuilding industry does not include any of the few very large shipyards that dominate the global market, it has a strong market position in building special naval vessels such as military ships, submarines, cruise ships, yachts etc. Focused specialisation and advanced technology capabilities define the leading position of Europe in specific areas of shipbuilding, and investment to enhance these competitive advantages is critical for maintaining this position (Wiesenthal et al, 2011).

Another area where Europe has a very strong position is the development and supply of marine equipment and systems such as electronics, cargo handling, propulsion systems, safety systems etc. In contrast to the shipbuilding sector that is dominated by large shipyards, the marine system suppliers are mainly small companies.

Finally, in the case of inland waterways, the vessels are smaller and so are the shipbuilding sites, while the demand can be served locally instead of by a few global very big shipyards. Hence, there is potential for local development and innovation. A relevant example is the case of the Innovative Danube Vessel (see Box 10).

Barriers and challenges

Ships have a relatively long lifespan, minimum 20 to 30 years. Therefore, the adoption of new technologies needs to have a long-term perspective and be well planned. Furthermore, the modification of existing ships in order to retro-fit new technologies can be costly. Developing more efficient retro-fitting techniques is one important challenge for the next two decades, and so is modular building as it can increase the efficiency of assembling, repairing and disassembling/ recycling of the ship.

One of the major challenges in the area of shipbuilding is the competition with non-European countries such as Japan, China and South Korea, where the majority of the biggest shipyards are located. In order for Europe to maintain its dominant position and grow its market share, sufficient targeted investments need to be made.

How to act?

Analysis

The first steps of the analysis should be to assess the relevant activity in the region especially in terms of ship constructing and equipment manufacturing/supplying, and to identify all relevant actors such as companies, research centres, organisations etc.

Furthermore, competitive advantages in terms of human resources capital, skills etc. need to be evaluated. An indication of the current state of regions can be found in the outputs of the METRIC work packages 3 (Konings et al., 2014a, b, c) and 4 (Hoppe and Winter, 2014 a, b) – some of them are presented later in the present document – while relevant data can be found in the METRIC database (<http://fp7metric.sf.bg.ac.rs/>).

The potentials of economic differentiation need to be explored in order to understand how to make the best out of existing resources, capacities and experience in the region. Finally, it needs to be explored how the interactions between actors can be enhanced and stimulated and how local companies can be supported.

Governance/Stakeholder involvement

The number of regions involved in waterborne transport in Europe is smaller than in other modes such as land or air transport, while the maritime sector is predominately international and has particular dynamics considering the roles of and relationships between owners, shippers, charterers and insurers. The main stakeholders to be considered in the context of a RIS3 development include the following:

- Shipbuilders/ shipyards
- Marine equipment suppliers and manufacturers
- Ship owners
- Research institutes
- Regulating authorities
- Freight companies or charterers
- Ship passengers
- Port operators and relevant human resources
- Shipping consultancies

International organisations or other associations that can have significant impact, hence need to be involved include the following:

- International Maritime Organisation, is the United Nations specialized agency for safety and security of shipping and prevention of marine pollutions by ships. Its major work is to set standards and create regulatory framework for the shipping industry.
- European Community Shipowner's Association, is the trade association representing the national shipowners ' associations of the EU and Norway. They promote the interest of the European shipping industry and help formulate EU policy on critical maritime transport-related issues.
- Community of European Shipyards' Associations represents the shipbuilding industry from 17 Member States.

- SEA Europe – European maritime technology industry, supporting European companies involved in the building, construction, maintenance and repair of all types of ships and other relevant maritime structures.
- European Marine Equipment Council, representing European trade associations related with the marine equipment.
- European Council for Maritime Applied R&D, focusing on a common strategy for European Research in the maritime industry and the set-up of relevant research priorities for EU funded R&D.
- ERA-Net MARTEC II: this initiative aims to strengthen the European Research area in waterborne research by coordinating and developing synergies between national and regional maritime research programmes and policies.
- Confederation of European Maritime Technology Societies is an independent confederation of professional institutions and learned societies in the field of maritime technologies.
- European Barge Union, represents the inland navigation interest towards the European and international institutions.
- EU Technology Platform for the waterborne sector (WATERBORNE-TP) represents stakeholders from the waterborne sector and is responsible for setting up a shared Vision and a Strategic Research Agenda about innovation efforts in this sector.

Priority setting

Regions may define their priorities based on existing skills, resources and competitive advantages. Furthermore, the potentials of diversification of regional capacities need to be closely considered in order to rationally define a plan of innovation priorities. Relevant issues identified in the context of the Strategic Transport Technology Plan include the following (European Commission, 2012b):

- Two broad areas are pointed out of major interest for the maritime which are efficiency and safety. For efficiency and particularly energy efficiency, the use of Liquefied Natural Gas in waterborne transport will reduce the emissions significantly. Other propulsion-related issues such as fuel cells, hybrid ships, superconductors and electricity storage need to be further investigated as they may have good potentials to be implemented in waterborne transport.
- Another area worth investigating is the increase of efficiency of shore-side electricity by using conversion devices such as fuel cells.
- In the area of materials, steel plates can be substituted by hybrid materials and carbon fibre in order to reduce the weight of vessels. Other attributes that can improve the efficiency of vessels include the use of environmental-friendly hull coatings, optimised propellers and hull shapes, air bubble lubrication, air cavity systems and turbulence control systems.
- Furthermore, innovation should address the development of sophisticated stowage systems, automatic ballasting systems and further automation of on-board processes while safety and efficiency can be increased with the use of new information and communication technologies.

Policy mix

Structural funds could primarily maintain and foster the knowledge base of regions with proved assets in the maritime technology industry. Regional policy-makers should be focusing on creating a supportive environment for the development of the sector, including actions such as:

- Subsidising research and development of naval equipment and technologies

- Creating clusters to promote knowledge exchange between maritime technology SMEs
- Supporting intra-regional and inter-regional communication channels (i.e. trans regional projects) between different players (yards, engineering companies, specialized suppliers, etc.).
- Supporting PPPs for i.e. demonstrators, prototyping or participation in research and innovation projects
- Incentivising the adoption of new equipment and technologies

There have been several European-wide initiatives to support the sector, including the following:

- Horizon2020, which includes funding for the waterborne sector, under its call of 'Mobility for growth'.
- Connecting Europe Facility
- The initiative LeaderSHIP 2020 by the European Maritime Technology Industry originating from the LeaderSHIP 2015 initiative
- The European Action Programme for Inland Waterway Transport (NAIADES II)
- The ERA-NET coordination action MARTEC launches calls for collaborative research in different areas of maritime technologies.
- Marco Polo, see section 2.4.
- Danube Strategy, for riparian countries of the Danube river.

Box 9 - LeaderSHIP 2020

In 2002 the European shipbuilding industry developed a vision and a robust strategy for 2015 to ensure its "long term prosperity in a dynamic growth market". The LeaderSHIP 2015 strategy was subsequently developed with the European Commission in close collaboration with the industry. It was successful at becoming a role model for a modern industrial policy.

The LeaderSHIP 2020 initiative, adopted in 2013, enlarges the previous strategy offering a vision for the industry (innovative, green, specialised in high tech markets, energy efficient, diversifying into new markets etc.) based on 4 pillars:

- Employment and skills
- Improving market access and fair market conditions
- Access to finance
- Research, development and innovation

Box 10 - Innovative Danube Vessel

(taken from <http://www.danube-navigation.eu/>)

The main objective of the project was to offer recommendations for modernising the Danube fleet, considering:

- Requirements of the transport market in the Danube region
- Specific fairway and navigation conditions of the Danube river
- The state of the art in inland waterway vessel technology
- Innovative technical solutions derived from published research projects

It was found that under good waterway conditions transportation carried out with Danube vessels can reach excellent cost and energy efficiency. Innovative devices and optimised ship designs would further improve this situation.

Regarding new constructions, the most promising options to achieve energy and cost savings and reduced environmental impact are the following: two new types of Danube pushers and an innovative version of a self-propelled vessel. Quick wins can be realised by installing real-time voyage speed optimisation tools on existing Danube vessels.



Smart specialization in regions involved in the EU Strategy for the Danube Region has been successful in achieving a critical mass to tackle major common challenges and avoiding duplication in regional investments.

Smart, green, low-maintenance and climate-resilient infrastructure

Why invest in smart, green, low-maintenance and climate-resilient infrastructure?

Infrastructure plays a critical and pivotal role in achieving most of the environment or safety-related goals regarding transport that have been set regionally, nationally or at European level. In the transport White Paper (European Commission, 2011a) several targets imply an improvement or extension of existing transport infrastructure. This is the case of the 50% shift of road freight over 300km to other modes by 2050, or those envisaging a shift to rail –such as the extension of high-speed rail by 2030 by tripling the length of the existing network, the construction/maintenance of a dense railway network and the aim to connect airports and seaports to the rail network. Moreover, a high quality, multimodal and fully operational network to cover all EU Member States should be completed by 2050, the TEN-T network, together with the relevant system for information services.

On the other hand, the use of ecological materials will reduce the environmental cost of new infrastructure construction, while investing on ways to increase the lifespan of the network and reduce the maintenance needs, substantial decreases the actual cost. In fact, maintenance of infrastructure is very costly and in most Member States it amounts to annual budgets comparable, in cases even larger, to the infrastructure investment budgets. In the case of roads, the International Transport Forum

estimated the share of maintenance costs in total road expenditure to be between 25% and 35% for European countries (International Transport Forum, 2012).

Research on impacts of climate change on transport infrastructure will be determinant to the promotion of climate-resilient infrastructure. Relevant impacts were considered in the PESETA project (<http://peseta.jrc.ec.europa.eu/>), including rail buckling and low water levels (to affect inland waterways) as results of increased summer temperatures, and reduced average precipitation, flooding and landslides as results of extreme precipitation. Furthermore, sea level rise and sea storm surges could put in risk coastal highways and railways, as well as ports and low-altitude airports. Current weather induced annual costs for Europe were estimated to be 10.4 billion euros for wear and tear of infrastructure and 629 million euros as costs from damages caused by extreme weather.

Barriers and challenges

The complexity of and competition in the transport infrastructures construction sector, together with the project-based nature of the construction work, have an adverse effect on its innovation capacity (Wiesenthal et al, 2015). As innovation potential is directly linked to investment ability, focusing on cost minimisation cannot create favourable conditions for innovation. The situation is further complicated by the fact that there is limited competition for large projects, such as the ones for the construction of transport infrastructure, as there are only a few large companies able to manage them.

A big challenge in the sector of transport infrastructure is to take advantage of the fact that it is the technical specifications and regulations that, to a large extent, determine the processes of construction and maintenance. This can stimulate innovation and, most importantly, guide it towards a desired direction such as the minimisation of environmental impacts. Green public procurement¹¹ has been successful in promoting the development of 'green' technologies and products, as well as their deployment in the market. This can be particularly important for small and medium size companies, as it offers an opportunity to find markets for their innovative solutions and products.

How to act?

Analysis

The analysis should start by identifying the key regional stakeholders and evaluating their innovation potentials in areas where they have proved research experience (through indicators such as R&D and patents), as in fields with potential cross-fertilization among other economic sectors.

Work with local partners in the identification of challenges and needs for development of new/existing transport infrastructure to be addressed by the region, emphasizing the issues related with smart, green, low-maintenance and climate-resilient infrastructure. This process should also include a prioritisation of subjects and possible means of intervention;

At this stage, determining the areas where new skills and professionals will be needed and estimating the costs of interventions and potential sources of funding, should also be considered.

Governance/Stakeholder involvement

The construction sector in Europe includes only a few but very large companies with national and international activity and a large number of small companies that operate locally and in most cases

¹¹ As defined in the Communication (COM(2008)400) ["Public procurement for a better environment"](#)

collaborate with the companies that manage the projects (Wiesenthal et al, 2011). A range of stakeholders should be considered for the development of Smart Specialisation Strategies in this field, including:

- Companies entirely or partly devoted to research in smart, green, low-maintenance and climate-resilient infrastructure.
- National authorities including ministries relevant to public works, transport and environment.
- Public authorities such as local departments relevant to planning and maintenance of the transport network.
- Transport authorities (road, rail, port, aviation and marine).
- Research institutes and universities.
- Companies of specialised equipment, e.g. manufacturers of signalling systems.
- Infrastructure operators, e.g. highways and toll operators.
- Transport or engineering consultancies.

In Europe there are several initiatives and platforms bringing together relevant stakeholders such as the following:

- European Construction Technology Platform, representing stakeholders related with construction of infrastructure, including transport infrastructure.
- European Network of Construction Companies for Research and Development (Encord) a forum for industry-led innovation in the construction sector.
- European Construction Industry Federation (FIEC), represents the interests of the European construction industry toward the European Institutions while helping knowledge of the sector among policy makers and the general public.
- European Council for Construction Research Development and Innovation (ECCREDI), focussing on research and innovation in the construction sector
- Council of European Producers of Materials of Construction (CEPMC), represents the interests of its Members at a European level, improving networking among its Members and monitoring European legislative, administrative and economic measures affecting construction.
- European Union Road Federation (ERF), representing stakeholders in the construction, equipment of Europe's road network, it coordinates the views of Europe's road sector, especially in the field of research.

Furthermore, the following research initiatives take place in Europe:

- The Forum of European National Highways Laboratories (FEHRL) brings together national road research and technical centres in Europe; research areas of interest include environment, economics, safety, materials and telematics.
- The Forum of European Road Safety Research Institutes (FERSI) aims to bring together researchers working on safety.

Priority setting

The regions have to identify the most appropriate ways to achieve smart, green, low-maintenance and climate-resilient infrastructure. Relevant priorities as identified by the European Commission (2012b) include the following:

- Enhancing the interoperability and inter-modality of network systems, including issues regarding national borders and interaction between Member States.
- Integrating information and communication systems and ensuring the resiliency of mechanisms and systems in order to be able to provide seamless services.
- Establishing multimodal centres to ensure the smooth interaction between modes for both passenger and freight transport.
- Using more eco-friendly materials and investing on relevant research regarding both manufacturing and adoption. Focusing on reducing waste from construction and technologies for recycling and reusing construction materials.
- Developing and implementing innovative technologies and infrastructures that will inform transport users and drivers about dangers.
- Developing ways that will increase the endurance and lifespan of existing infrastructure.

Policy mix

Relevant funding opportunities can be found in Horizon2020, while regions should focus on policies to support smart, green, low-maintenance and climate-resilient infrastructure such as the following:

- Incentives to invest in and adopt innovative methods in the field of smart, green, low-maintenance and climate-resilient infrastructure
- Support public private partnerships in this field
- Support R&D and deployment strategies in companies innovating in this research field.
- Green public procurement

Other funding sources include:

- Horizon 2020, which includes a specific call for research related with smart, green and more efficient infrastructure.
- Connecting Europe Facility
- MARTEC II, financing research related with increasing the security and efficiency of maritime infrastructures.
- Marco Polo, for projects related with rail, sea and inland waterway infrastructure
- SESAR, for projects related with the aviation sector.
- Shift2Rail Joint Undertaking, for projects related with rail infrastructure.
- ERA-Net Road, financing projects in the road sector
- ERA-NET Transport, launches specific call for research in the transport field. For 2015 a new call on 'Sustainable Logistics and Supply Chains' was opened, financing projects in the following research domains:
 - Cross-border freight transport corridors
 - Hub development
 - Urban / last mile logistics
 - Organizational innovations and new business models in logistics
 - Information infrastructure and services for logistics

Box 11 – Greenroad project



<http://www.greenroad-santander.com/en/>



The Greenroad project is a partnership between a construction company, Santander City council and the University of Cantabria. It aims to improve the sustainability of road infrastructure, by testing the feasibility of using at least 90% recycle mixtures in asphalt road construction. It also aims the reduction of the temperature required in the production process of asphalt mixtures and thus minimizes the energy consumption.

Greenroad asphalt will be tested in an area of 5.400m² and it will be compared with another similar area using normal asphalt. Furthermore the project will demonstrate the environmental and economic benefits of the use of waste in the production of asphalt, analysing the life cycle of normal and Greenroad asphalt.

Ultimately the project aims to significantly improve the application of the purchase green public construction contracts, so as to include a requirement for the use of green asphalt.

Europe-wide alternative fuel distribution infrastructures

Why invest in Europe-wide alternative fuel distribution infrastructures?

High targets regarding changes in the use of propulsion systems have been set by the European Commission and appropriate infrastructures need to be in place in order to achieve these targets. Use of cars with conventional fuels in urban transport is expected to be halved by 2030 and eliminated by 2050, while logistics in major urban centres is foreseen to become carbon-free by 2030. With reference to other modes, by 2050 the share of sustainable fuels in aviation needs to reach 40% and CO₂ emissions from maritime bunker fuels need to be reduced by at least 40% (European Commission, 2011a).

The potentials for the adoption of alternative fuel vehicles are directly related to the availability of alternative fuels, hence the production infrastructure and refuelling network. For some of the alternative fuels mentioned below, such as biofuels and synthetic fuels, refuelling issues can be addressed using the existing distribution infrastructure. As for electricity- and hydrogen- powered vehicles, which are the 'cleanest' propulsion technologies, the limited coverage of the refuelling/recharging network, together with the relatively low speed of refuelling and mileage that can be covered without recharging, have adverse effects on their attractiveness as competitive alternatives to conventional propulsion systems.

Barriers and challenges

One of the major barriers to invest in alternative fuel distribution constructions is high cost, which combined with an unsupportive regulatory framework can make investments risky. In order to give a boost to the sector of alternative fuels, besides restructuring the legislative framework, direct investments by the regions on distribution infrastructure may be necessary.

Regarding the challenges in the areas of production and R&D, the most important issues have to do with the cost of alternative fuels, distance to cover with a full tank or charge and refuelling/ recharging both in terms of infrastructure and time required; the latter refers mainly to recharging speed.

How to act?

Analysis

The analysis of regional potential in the sector of fuel distribution infrastructures should start by assessing the regional approach towards the adoption of alternative fuels including the current state of relevant infrastructures.

Also, the main stakeholders in the region need to be identified, while in the case of companies or research institutes need their skills and abilities to be evaluated in comparison to national and international competition; this will help to identify competitive advantages and relative weaknesses.

Furthermore, the regulatory framework needs to be assessed especially in terms of its ability to support and offer a stable environment for the growth of relevant initiatives. The necessary policy-making actions will also be identified. For example, the creation of networking platforms can be stimulated through the organisation of relevant workshops or meetings.

Governance/Stakeholder involvement

The stakeholders to be considered for the development of Smart Specialisation Strategies need to be from both the supply and demand sides of fuels. Main actors to be considered by the region may include the following:

- Major car manufacturers
- Research institutes and Universities
- Alternative fuel producers, as well as battery and fuel cell producers
- Energy companies active in the field of electricity or other alternative fuels
- Power-generation companies also involved in providing charging infrastructure
- Local and regional authorities with regulating power, which can help to create a supportive environment for the adoption of alternative fuels
- National authorities, ministries and relevant governmental departments
- Standards organisation such as CEN (European Committee for Standardisation)

Relevant associations and groups to be considered include the following:

- European Road Transport Research Advisory Council (ERTRAC); a technology platform which brings together relevant stakeholders in the field of road transport research. Among others, they have published the document 'Electrification of Road Transport' and have set up the Electrification Task Force.
- European Rail Research advisory council (ERRAC)
- Waterborne TP; is a technology platform of main stakeholders, committed to update the R&D requirements for European competitiveness, innovation of the waterborne sector.
- Advisory Council for Aeronautics Research in Europe (ACARE)
- European Biofuels Technology Platform (EBTP), responsible for establishing R&D priorities on biofuels and building consensus among main stakeholders.
- Fuel Cells and Hydrogen Joint Undertaking
- European Construction Technology Platform (ECTP)

Priority setting

Priority setting cannot ignore existing skills and potentials but needs to take into account some of the pressing issues regarding the adoption of alternative fuels and the growth of relevant distribution networks. Relevant issues are indicated by the European Commission (2012b) and include the following:

- Research and innovation focusing on modifying the existing petroleum-based infrastructure in order to be able to include higher-blend biofuels
- Investment on synthetic fuels both in terms of production and adoption. Regarding the former, production processes need to become more efficient and for synthetic fuels it should be possible to use the same infrastructures as for fossil fuels.
- For the promotion of hydrogen, innovative solutions are needed in the field of transportation, storage, and refuelling network.
- Additional efforts need to be made in order to take advantage of the full potential of Liquefied Natural Gas (LNG).
- As for electricity, the focus should be on the development of recharging infrastructure, wireless charging and two-way charging, and the reduction of charging time.

Policy mix

The European Commission has already set relevant targets that will increase the interest in research for alternative fuels. One example is the Renewable Energies Directive (European Commission, 2009b) according to which by 2020 at least 10% of the transport fuels in all EU countries must come from renewable sources.

Furthermore it has launched a "Clean Power for Transport" package that aims to facilitate development of a single market of alternative fuels for transport in Europe. This has given place to a Directive that requires Member States to develop national policy frameworks for the market development of alternative fuels and their infrastructure; foresees the use of common technical specifications for recharging and refuelling stations and paves the way for setting appropriate consumer information on alternative fuels.

Regional development in this area should consider the objectives lay down by European and national authorities. It should also refer to specific actions and the budget allocation and to the source of funding.

Relevant funding schemes and relevant platforms and initiatives include the following:

- Horizon 2020
- Connecting Europe Facility
- CIVITAS
- ELENA, is a European Facility aiming through technical assistance, at supporting regional or local authorities in accelerating their investment programmes in the fields of energy efficiency and renewable energy sources.
- The European Energy Efficiency Fund (EEEF), provides market-based financing for commercially viable public energy efficiency, renewable energy and clean urban transport projects.
- ERA-NET Transport launches regular transnational calls for coordinate national/regional funding for RTI projects, called Flagship initiatives. In addition to these Flagship initiatives, other calls for RTI projects may be launched from different Action Groups
- MARTEC, this ERA-NET for maritime technologies, in its 2015 call defines one of the priority areas as "offshore structure for renewable energy".
- European Green Vehicles Initiative (EGVI); a contractual public-private partnership funding research in green vehicles and sustainable mobility systems.
- Clean Sky JTI (Joint Technology Initiative); an European aeronautical research programme, focused on develop breakthrough technologies that increase the environmental performance of airplanes and air transport. Specific calls can be found in the field of alternative fuels.
- Fuel Cells and Hydrogen Joint Technology Initiative; is a public private partnership that supports research, technological development and demonstration activities in the field of fuel cells and hydrogen technologies in Europe. Partners include the European Commission, fuel cells and hydrogen industries and the research community. Funding opportunities can be found in the field of refuelling infrastructure.

Box 12 - Magnun Cap's New Park Charge Solution

Source: http://ec.europa.eu/regional_policy

The project was co-financed by the ERDF and has developed a range of electric charging system prototypes for transport based on renewable energy, which contributes to wider deployment of electric vehicles. Four prototypes have been developed within the project: 1) a two-wheel charging system; 2) a normal charging system; 3) a home charging system; and a 4) quick charging system.

Magnun Cap benefited from new opportunities regarding the supply of electronic vehicle-charging products, remote charge monitoring and management tools and a range of related services. The company now exports 50% of its products.

Efficient modal traffic-management systems

Why invest in *efficient modal traffic-management systems*?

Traffic management systems such as Intelligent Transport Systems (ITS) or advanced traffic management systems for other modes can play – in fact they already do – a very important role in achieving the emission reduction targets set in the transport White Paper, as well as in improving the efficiency of roads in terms of reducing congestion and travel times.

In general, Information and Communication Technologies (ICTs) can help to improve safety and information of transport users. Furthermore, they can offer relatively cheap solutions once the necessary infrastructure exists, and can increase the efficiency of the management of transport systems, the speed of the response of logistic companies, the speed of data collection and analysis, and in general the competitiveness of transport and logistics suppliers.

To achieve the best possible results, in-parallel development of the technological, organisational and regulatory systems is necessary. The continuing development of technologies such as ICTs creates new opportunities that might not be possible to be covered by the existing regulatory framework. Furthermore, only traffic management systems by themselves could not sufficiently address pressing issues such as congestion because users tend to change their mode choices according to traffic conditions. As a result, besides manufacturing of traffic management tools the optimisation of services and incorporation of management systems should also be in the focus of regions interested in this sector.

At the moment there are several information and traffic management systems at the European scale including the following:

- European Rail Traffic Management System (ERTMS)
- Vessel Traffic Monitoring and Information Systems (VTMIS) and SafeSeaNet
- River Information Services (RIS)

- European Electronic Toll Service (EETS)

Barriers and challenges

There are several issues relevant to the increasing presence of technology in traffic-management such as the contrast between the rapid development of technology – in this case ITS or transport-related ICTs – and the long lifespan of transport infrastructures. Hence, ways for efficient and cost-effective update of transport infrastructures need to be identified while transport planning needs to take as much as possible into account expected changes.

One issue relevant to the technological sector is the uncertainty/risk of investing to new products. A key policy step for road transport has been made with the Directive 2010/40/EU (European Commission, 2010) which indicates the requirement for adoption of specifications to ensure compatibility, interoperability and continuity of Intelligent Transport Systems across the EU.

Another issue, which becomes increasingly relevant as the type and amount of private data that can be collected by information technology systems increases, is securing privacy while benefiting from available information. Regulation and standards need to be developed and updated in order to enable users to take the most out of new technologies while addressing issues such as privacy or data-sharing between companies and platforms.

Furthermore, the policy framework for the protection of privacy and personal data also exists: Directive 95/46/EC (European Commission, 1995) refers to free movement of data and Directive 2002/58/EC (European Commission, 2002) refers to the protection of privacy in the electronic communications sector.

How to act?

Analysis

Many regions are expected to have, as users, a traffic management system in place and the current state of the region needs to be assessed in order to identify advantages and gaps. The interest of the region in investing in traffic management systems is expected to be affected not only by existing skills but also by the region's specific needs, hence the potential of the region may depend on existing infrastructure such as roads, ports, logistic sites etc.

Furthermore, the regulatory and institutional framework of the region needs to be analysed, relevant actors from the side of both development and deployment need to be identified and the current state in terms of skills and resources needs to be evaluated.

Finally, either in comparison to other regions or independently, the actions that need to be taken in order to enhance innovation need to be identified. Among them, actions to stimulate collaboration and investments are included.

Governance/Stakeholder involvement

There is a range of stakeholders interested in the innovation potential of traffic management systems including manufacturers, operators and end-users. Among them can be found the main actors to be considered for the preparation of Smart Specialisation Strategies and they may include the following:

- Automotive industry and other vehicle manufacturers

- Manufacturers of vehicle equipment
- Developers of relevant software
- Telecommunication companies
- Operators as of highways, public transport, ports and airports
- National, regional and local authorities
- Passengers and drivers associations
- Constructors of infrastructure
- Research institutes and universities working on relevant areas

Approaching associations and partnerships can be a very useful step for regions willing to specialise in the area of traffic management systems. Relevant initiatives include the following:

- ERTICO – ITS Europe, providing a platform for international collaborative research and development in various ITS domains
- European Council for Automotive Research and Development (EUCAR), specially interest in ITS applications to road vehicles
- European Automotive Research Association (EARPA), which includes a task force on electronic and communication systems
- European Road Transport Research Advisory Council (ERTRAC), especially the working groups of 'Urban mobility' and 'Road safety and security'
- Single European Sky (SES) and more specifically the part focusing on technology: SESAR (Single European Sky Air Traffic Management Research) which funds exploratory research and demonstration projects.
- European Rail Research Advisory Council (ERRAC)
- Electronic Components and Systems for European Leadership (ECSEL Joint Undertaking). This is a PPP that supports the development and deployment of electronic components and systems, a key enabling technology essential for the smart mobility applications.
- Polis, which includes a working group on traffic efficiency and mobility, especially relevant for this transport field.

Priority setting

In order to maximise the benefits from the use of efficient traffic management systems it is important to tackle any deployment-related issues. Deployment-related priorities as identified by the European Commission (2012b) include the following:

- Smart fee collection system that will practically implement the 'user pays' approach as charges will depend on external costs, congestion levels etc.
- Automated vehicle identification using technologies such as plate recognition, navigation systems etc.
- Automated vehicle classification systems using image capturing, sensors and data storing technologies.

Furthermore, systems that need to be further developed as identified by the European Commission (2012b) include the following:

- Open standard electronic platforms to exchange information of the vehicle such as location, speed, safety etc. In this context, privacy issues need to be addressed. Furthermore, interoperability between different systems needs to be secured.

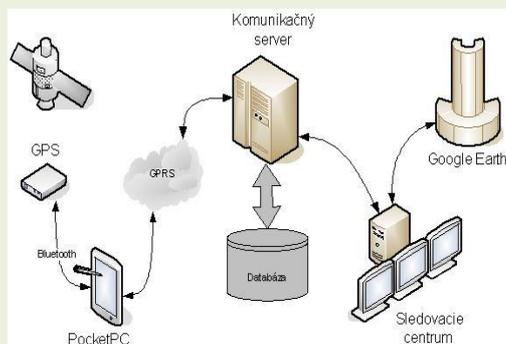
- Real time data collection and information systems on congestion, infrastructure-related issues etc. Interoperability between different systems is an issue that needs to be addressed also in this case.
- Technical standards for exchanging information and data.

Policy mix

Given the complexity, size and socio-economic and environmental impact of projects in this field, synergies with other actors and funds are essential. Funding opportunities can be found in:

- Horizon 2020, under the specific call for 'Intelligent transport systems'
- CIVITAS
- SESAR Joint Undertaking; was created by the European Union and Eurocontrol in order to ensure the modernisation of the European air traffic management system. This initiative coordinates and concentrates all relevant research and development efforts in the Union, funding important exploratory research and demonstration projects.
- Electronic Components and Systems for European Leadership (ECSEL Joint Undertaking); is an European PPP that offers funding for research, development and innovation projects on electronic components and systems. Particularly for transport, it finances projects related with smart mobility that can be combined with other research funds such as Horizon2020 and structural funds via ESIF/ERDF.
- MARTEC II, financing projects in the maritime sector
- 'Shift2rail – Joint Undertaking'. (See section 2.4)
- Connecting Europe Facility: especially under the objectives of supporting sustainable and efficient transport systems.

Box 13 - New Centre of Excellence in North-Western Slovakia



Source: http://ec.europa.eu/regional_policy/

The project was 85% co-funded by the EU, with national funds making up the rest of the total cost. It integrated four research facilities for the development and production of intelligent transport systems. It aimed to create a multidisciplinary institution, studying solutions to common transport and traffic challenges.

Piloted by the University of Žilina, the project looked at everything from signal processing to user-friendly data display.

The project also developed promising solutions for designing evacuation plans for places that are threatened by a disaster of some kind.

Integrated cross-modal information and management services

Why invest in *Integrated cross-modal information and management services*?

Integrated cross-modal information and management services can play a significant role in changing mobility behaviour in the case of passenger transport and improving the efficiency of the logistic chain and freight transport. Establishing the framework for European multimodal transport information, management and payment services by 2020 is one of the main targets of the transport White Paper (European Commission, 2011a)

Passenger and freight transport are different cases as regards the application of cross-modal information and management services, and the issues and solutions to be considered. In the case of passenger transport, advantages from the deployment of integrated cross-modal information and management services include the following: improvement of service through better coordination, simplification of ticketing systems and reduction of cost by reducing administration. Furthermore, monitoring of the system through ITS and provision of information with the help of ICTs is important for the optimisation of services.

In the case of freight transport, cross-modal integration will reduce the cost and improve the efficiency of the system while it can make it greener. Moreover, the creation of cross-modal logistic stations will increase the competitiveness of the region.

Barriers and challenges

The main barriers for establishing efficient cross-modal information and management services have to do with the regulatory framework, the development of systems that will allow effective cross-modal management and exchange of information, and the distribution of costs and benefits.

The development or adaptation of intermodal infrastructure can be very expensive and for the necessary investments to be made, appropriate incentives need to be given. Additionally, in order to secure that any profits from such investments will be fairly distributed, efficient pricing systems need to be in place.

How to act?

Analysis

The first step of the analysis should be the assessment of the existing governance scheme and the evaluation of potentials to change the regulatory structure towards one that will be favouring the establishment of integrated management systems.

Then, existing infrastructure and activity need to be evaluated in order to assess cross-modal development potentials. It is expected that cross-modal management systems would be interesting for areas with multimodal freight and logistics activity, e.g. waterborne and rail transport, or for urban areas.

In parallel, the main relevant stakeholders need to be identified while it is important to assess the level of skills and the availability of resources. Finally, the policies that would enhance the collaboration between different stakeholders and the regulatory changes that would incentivise the development of cross-modal management systems need to be explored.

Governance/Stakeholder involvement

Stakeholders that need to be taken into account for the development of Smart Specialisation Strategies focusing on cross-modal information and management services in the area of freight transport include the following:

- Port and airport authorities
- Rail companies
- Logistics service providers and distributing companies
- Shipping companies
- Road freight enterprises, e.g. trucking companies
- Very big retailers with logistics facilities
- Local and national authorities relevant to transport and infrastructure
- Research institutes and universities
- Specialised consultancies
- IT companies and software developers working in the field

In the case of passengers transport the following are relevant stakeholders:

- Transport authorities
- Transport operators (rail, light rail, metro, buses, roads etc.)
- Transport consultancies
- Passenger associations
- IT companies and software developers working in the field
- Local authorities

Finally, relevant European professional associations and partnerships that can be of interest for the region developing Smart Specialisation Strategies include the following:

- European Intermodal Association (EIA), provides comprehensive information on intermodal freight transport in the field of company profiles, best practise, legislation, news and events
- European Inter-modal Research Advisory Council (EIRAC) that has developed the Strategic Intermodal Research Agenda (SIRA) for the year 2020
- European Conference of Transport Research Institutes (ECTRI), with specific working groups on Mobility, freight and logistics and traffic management
- International Association of Public Transport (UITP)
- European Metropolitan Transport Authorities (EMTA), this association provides a platform for exchanging information and best practices between public authorities in the field of planning, integrating and financing public transport services.
- Polis

Priority setting

In order to define their main priorities, regions need to assess their regional advantages and skills. From the technological point of view, areas that need to be further investigated and developed in order to move towards the deployment of integrated cross-modal information and management services include the following (European Commission, 2012b):

- Ensuring the compatibility of management and interfaces among different modal networks, between long-distance and local networks and across borders.
- Offering integrated, cross-modal, cross-border and real-time information to all transport users in order to secure the smooth operation of inter-modality.
- Structuring timetables taking into account all modes to minimise delays during cross-modal interchanges.
- Developing smart navigation and routing systems with multi-modal information able to offer a variety of alternatives based on different criteria, e.g. environmental etc.
- Offering simple and smart integrated reservation, ticketing and charging systems covering all public transport modes.
- Establishing single ticket systems where relevant, e.g. urban transport.

Policy mix

Policies to boost innovation in inter-modality issues should focus on removing any barriers identified in the analytical process, enhancing the coordination among the multiple actors that by default need to be involved and incentivising private stakeholders to take action.

Innovation efforts in this field may also benefit from the improvement of interoperability of standards and services, the enhancement of coordination between information services, the adoption of navigation systems and network management tools, the deployment of smart ticketing and charging systems, the implementation of systems to exploit real-time data, either in terms of informing users or improving network management.

Especially in the case of passenger transport integrated governance schemes, such as metropolitan transport authorities, should improve the coordination between different stakeholders and modal authorities.

Regarding complementary funding opportunities, specific calls can be explored in:

- Horizon 2020
- Connecting Europe facility
- INTERREG EUROPE programme aims to improve the implementation of regional development policies and programmes. Four themes were selected in order to make the best use of limited funds, with one in particular relevant to transport i.e. low-carbon economy which can be achieved by promoting multimodal sustainable transport.
- MARTEC II, for maritime services
- ERA-Net Road
- Marco Polo
- Polis

Box 14 - LOGICAL project



Source: http://ec.europa.eu/regional_policy/

The LOGICAL project, mainly financed by ERDF, develops an ICT tool that enhance logistics services across Central Europe, by integrating cloud computing into the daily routines of operators and infrastructure providers.

Beneficiaries of this transnational cloud computing tool are small and medium-size logistic enterprises that have limited resources for licensing software systems. In general the tool reduces transaction costs, increases intermodal co-operation in a common cloud computing system and provides an online learning tool for capacity building of logistics actors.

Box 15 - Finland's multi-modal transport service package



Source: Eltis

Finland is developing and piloting the world's first door-to-door mobility service. Supported by Tekes, the Finnish Funding Agency for Innovation, and the Ministry of Transport and Communications the concept is based on several approaches, one of which allows people to buy packages similar to mobile bundles, which provide them with different transport options to get them seamlessly from one location to another.

Seamless logistics

Why invest in *Seamless logistics*?

Seamless logistics will contribute significantly in the achievement of the targets to create clean, safe, smart and efficient transport. By optimising freight transport, the service level will be improved while cost and environmental impacts will be reduced. To achieve seamless logistics different modes need to be smoothly combined, while delays and interruptions in the logistic chain need to be minimised.

Potentially positive consequences of seamless logistics development include shifting to environmental friendly modes at any of the stages of the logistic chain (e.g. to rail for transportation from terminals or electric vehicles for distribution in cities), improving fleet management to optimise truck loads and scheduling, and improving delivery management (e.g. avoiding single item deliveries, making quite night deliveries, assigning parking for loading and unloading).

Relevant potential developments include creating appropriate logistic centres and terminals, optimising operations and increasing the fleet of environmental-friendly vehicles. Very important for the optimisation of operations is close monitoring, data collection and data analysis; this is an area where research and innovation can contribute significantly.

Barriers and challenges

An important barrier for achieving seamless multimodal freight transport services in a region is the cost of infrastructure. In the case of regions with significant international logistics activity, such infrastructure might have to do with cargo transferring from mode to mode, e.g. from waterborne to land transport. On the other hand, in regions with predominately urban character, the issue might have to do with the efficient connection of urban and interurban freight and distribution services.

The success of EU-wide seamless logistics depend on how different governments will address security issues, the promotion of minimum disruptions and interoperability between different systems by addressing both technological and administrative issues. It will also depend on the combination of effectively navigation systems with real time traffic data in order to improve route and congestion related provision of information.

How to act?

Analysis

The analysis of the potentials of the region should start with the identification of the main stakeholders and continue with the evaluation of activity both in terms of freight transport and technology production. The skills in relevant sectors such as navigation software development, logistics management and freight operations need to be assessed, as well as the level of existing infrastructure and the potential benefits from innovation. Finally, the potentials in terms of support need to be examined in connection to forecasted benefits.

Governance/Stakeholder involvement

The achievement of seamless logistics can be benefited by the adoption of flexible and comprehensive – i.e. where all relevant stakeholders will be represented – governance structures. Stakeholders that need to be involved in the design of Smart Specialisation Strategies include the following:

- Logistics centres
- Shipping companies and ship-owners
- Rail operators
- Freight companies
- Trucking companies and distributors
- Port and airport operators
- Specialised software and application developers
- Research institutes and universities

- Specialised technology companies focusing on R&D such as university spin-offs
- Consultancies in the area of logistics and transport

Most relevant associations and partnerships have already been mentioned in the previous section (Integrated cross-modal information and management services) and include the following:

- European Intermodal Association (EIA)
- European Inter-modal Research Advisory Council (EIRAC)
- Polis

Priority setting

The European Commission (2012b) has identified the main research and innovation areas for the development of seamless logistics. They include the following:

- Systems and technologies to improve the multimodal management of freight transport such as intelligent fleet management systems, real time information in navigation systems, trip planning technologies and software. Better planning and use of more information will reduce travel times while it can limit the exposure of environmentally sensitive areas to freight traffic
- Intelligent cargo handling solutions in consolidation and distribution terminals that will make use of real-time data in order to enable multimodal freight and tracking of items, and to improve planning of deliveries
- Optimisation of delivery services in urban areas (e.g. home deliveries) including reduction of environmental cost of urban logistics
- Vehicle tracking systems to assist in the enforcement of restrictions
- Cargo tracking and tracing systems to provide information during all parts of the logistic chain
- Interoperability of different tracking, tracing and monitoring systems

Policy mix

Policies to stimulate innovation in multimodal terminals are necessary in regions with significant international freight activity. Furthermore, investments by the region itself may need to be considered as a measure to boost freight transport activity.

Creating the appropriate environment for the growth of innovative technological and R&D companies may require setting up a supportive regulatory framework that will drive technology adoption and backing innovation either through direct investments or with the provision of financial incentives. An important help for the latter can be the creation of support clusters such as the Logistics and Transport Cluster in Lower Austria (Box 16).

Targeting to increase energy efficiency and reduce environmental impacts, the European Commission supports the concept of Green Corridors where technology and multi-modality are important tools for improving performance in terms of energy, emissions, costs and outputs.

Furthermore, the European Commission in the transport White Paper (European Commission, 2011a) indicates the need for the creation and deployment of an 'electronic waybill' and the adoption of an appropriate framework in order to implement concepts such as 'single window' and 'one-stop administrative shop'.

Box 16 - Competence field logistics & transport, ecoplus

Source: <http://www.ecoplus.at/en/ecoplus/cluster/logistics>



Ecoplus is the business agency of the state of Lower Austria. They are offering services for the development of Lower Austria as a business location and are focusing on several competence fields including Logistics and Transport.

"The competence field logistics & transport is a service centre and point of contact for all innovative companies that consider logistics a success factor and recognise potential in logistical challenges. Transport logistics and freight transport affect key work activities. Nestled in the business field cluster of Lower Austria, the competence field logistics & transport offers all companies an information and service centre for all their logistical issues."

Complementary funding opportunities can be explored in specific calls, such as:

- Horizon 2020
- ERA-NET Transport launches regular transnational calls for coordinate national/regional funding for RTI projects. Currently a new call has been launched in the field of 'Sustainable logistics and Supply Chains'
- MARTEC II, for maritime services
- CIVITAS

Integrated and innovative urban mobility and transport

Why invest in Integrated and innovative urban mobility and transport?

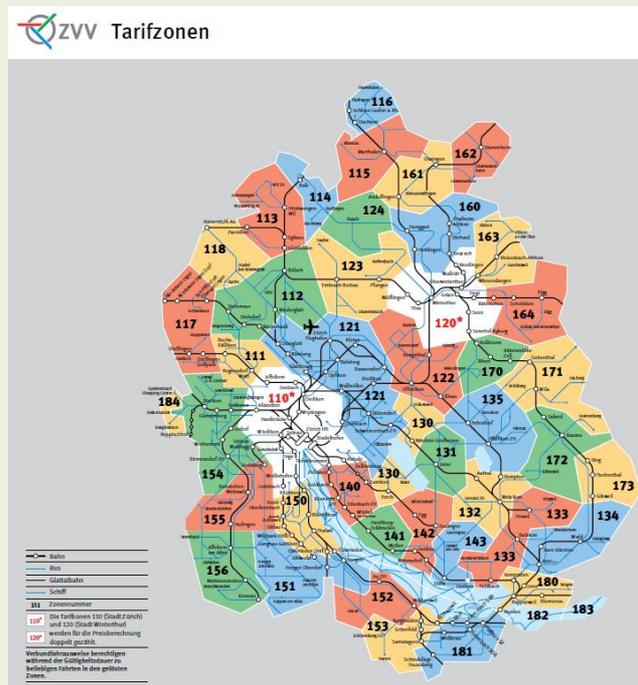
Urbanisation in Europe has been more intensive than the world average; almost 73% of the population has been estimated to be residing in urban areas in 2010, while this percentage is expected to rise to 82% by 2050 (United Nations, 2014). Furthermore, a significant part of economic activity takes place in cities where approximately 85% of the EU's GDP is generated (European Commission, 2009a). The agglomeration of population and activities in urban areas creates a pressing need for integrated and innovative urban mobility and transport in order to address environmental issues and to ensure sustainable growth.

Although several of the issues relevant to integrated and innovative urban mobility and transport have been covered in previous sections, it is important to dedicate a section to urban mobility not only because it is one of the ten innovation fields presented in the STTP, but also because of the scale of potential impacts. As stated by the European Commission (2009a): "Urban transport systems are integral elements of the European transport system and as such an integral part of the Common Transport Policy under Articles 70 to 80 EC Treaty". In addition, other EU policies (cohesion policy, environment policy, health policy, etc.) cannot achieve their objectives without taking into account urban specificities, including urban mobility." Agglomeration in cities can drive not only economic but also environmental efficiency of urban systems". Furthermore, most of the cities are facing common problems such as congestion, air pollution, urban sprawl, noise, security. Another area of interest for both passenger and freight transport is the integration of urban with inter-urban and long-distance transport which has been covered in previous sections.

Regarding passenger transport, the only realistic at the moment solution remains public transport. Hence, the focus of this section will be on relevant issues such service improvement and passenger attraction and more specifically on quality, reliability, real time information, data collection and analysis, safety, security and accessibility. Obviously, a large part of innovation will take place in the areas of technology and ICTs, as relevant capabilities need to be explored and exploited. But governance forms can play a very important role in the efficiency of urban transport systems and having a single coordinating authority can address several mismanagement issues and direct public transport development more efficiently. A paradigmatic case in terms of management and operation is the transport system of Zurich which is managed by a single transport authority, namely ZVV (Zürcher Verkehrsverbund). The regional perspective of integrated and innovative urban mobility and transport is obvious and several structures to support regions that wish to invest in this sector already exist (Box 17).

Box 17 - The Zurich transport system

(<http://www.zvv.ch/zvv/de/home.html>)



(Figure taken from the 'Tickets und Preise' brochure: <http://www.zvv.ch/zvv/de/service/publikationen.html>)

The Zurich transport system is governed by the ZVV transport federation since 1990. ZVV is a public authority under the governance of the Canton of Zurich. It is operating as a holding company as it fully finances the 8 transport companies (figure below) and the transport system in the area. Around 60% of the financing comes from revenues and the rest (i.e. the deficit) comes from the canton and the municipalities. The municipalities' contribution is based 20% on the commune's financial strength and 80% on the level of service offered.

ZVV is the coordinator of the transport system and not actively involved in the implementation of policies. As ZVV fully finances the system, the operators are not driven by profit. The income of companies and operators is determined by contracts but companies have control on their revenues, e.g. when they sub-contract transport operators. (Christodoulou and Finger, 2012)

Barriers and challenges

Besides other challenges mentioned in previous sections (especially those related with Integrated cross-modal information and management services and Seamless logistics), an important challenge for the achievement of integrated urban mobility, is the adaptation of management systems and governance mechanisms according to technological developments. Technology offers new tools for ticketing and information and even more, it can facilitate the participation of people to decision-making. Inflexible management and governance systems may find difficulties to address such issues.

Efficient data exploitation and information based on real data include technological challenges, although significant developments have taken place and there are several successful examples.

Cost is a barrier also in this case, as urban public transport requires significant investments and there are very few examples in the world where it actually brings profits. Public investment is necessary but there are several support schemes for urban transportation within the European Union.

How to act?

Analysis

The analysis of regions with an interest in integrated and innovative urban mobility and transport should focus on three main axes: (a) evaluation of the barriers set by the existing regulatory framework and identification of ways to overpass them, (b) assessment of current level of infrastructure and identification of the immediate priorities for the integration of public transport and (c) assessment of the current level of deployment of ITS and ICTs, as well as of the capacity to develop technology-based tools and the potential for the tools to be adopted by users.

Governance/Stakeholder involvement

The main stakeholders to be considered in the design of Smart Specialisation Strategies for integrated and innovative urban mobility and transport include the following:

- Metropolitan, urban and local authorities
- Transport authorities
- Public transport operators
- Highway operators
- Distribution and logistics companies
- Taxi companies and associations
- Passenger and drivers association
- Software and application developers
- Research centres and University

Additionally other European entities are producing an important knowledge base in the field of integrated and innovative urban mobility and transport, such as:

- ELTIS, the Urban mobility observatory. Provides useful information on funding and best practices.
- European Innovation Partnership on Smart Cities and Communities. It aims to help cities, communities, business and civil society to apply innovative solutions to tackle issues such as congestion and sustainable urban mobility.

Priority setting

Most of the relevant priorities have already been mentioned in the previous fields. In general, a key priority should be the shift to public transport and many of the actions should be focusing on this target. The main targets as indicated in European Commission (2011b) include the following:

- Integrated packages of innovation and technology for clean transport, reduction of car use, shift to public transport, mobility management, safety and security, transport telematics and urban freight logistics
- Development of integrated local strategies for sustainable urban mobility
- Citizen participation and involvement of the society
- Aligning Urban Mobility Plans with Integrated Urban Development Plans as defined in the transport White Paper

Policy mix

Regional policies should be focusing on creating flexible, comprehensive and independent regulatory and governance structures, as well as incentivising and enabling the adoption and integration of new technological tools. As has already been mentioned, considering the nature of public transport, public investments may be necessary but an efficient pricing system can improve the way that costs are distributed.

Relevant initiatives supported by the European Commission include the following:

- The Covenant of Mayors is a European initiative against climate change including local and regional authorities. Participants have agreed to meet CO2 reduction objectives by increasing energy efficiency and using renewable energy sources. It is a very good example of promoting multi-level governance because of the direct inclusion of local stakeholders for the achievement of EU objectives
- CIVITAS is an initiative that has helped to introduce various innovations and measures in order to reduce the environmental impact of urban transport in many European metropolitan areas
- European Innovation Partnership for Smart Cities and Communities, formed by representatives from industry, research and cities, promoting different Smart City concepts. This partnership supports actions under Horizon 2020, Structural Funds and private investments, including large scale projects (Lighthouse projects) and other projects and activities
- Innovative actions in sustainable urban development, a new call will be launched in 2015. The idea is to experiment with ideas on a real scale (pilot projects) to assess whether they can be transferred to other cities
- LIFE is the EU's funding instrument for the environment. The main objective of LIFE is to contribute to the implementation, updating and development of EU environmental policy and legislation by co-financing pilot or demonstration projects. The 2014-2017 work programme includes a thematic priority on 'air quality and emissions, including the urban environment'
- Intelligent Energy Europe Programme (STEER). Activities funded are those promoting a more sustainable use of energy in transport, with a specific focus on alternative vehicle propulsion, policy measures for the more efficient use of energy in transport, and strengthening the knowledge of local management agencies in the transport field
- URBACT III programme supports cities with the design and implementation of integrated urban strategies, building on mutual learning and the transfer of good practices. It develops three type of interventions:
 - Transnational exchange
 - Capacity-building
 - Capitalisation and dissemination.

Box 18 - Future Bristol

(<http://www.futurebristol.co.uk/>)



Future Bristol, a digital project conducted in partnership with local university, provides a way to engage the local community into the discussion of different options that might bring about a low-carbon future for Bristol. Two scenarios were conceptualized following a four-year project, which include summaries on ideas related to sustainability. The website allows visitors to read more and vote on whether they are good or bad ideas.

Scenario X suggests measures such as more charging points for electric vehicles; low-emission buses; high-speed electric rail connections to other parts of the UK; and increased air traffic at Bristol airport with low-emission aircraft. Scenario Y suggests making car-sharing more common to reduce private car trips; introducing a smart card that integrates bus and tram travel; promoting walking and cycling; expanding local rail networks as well as fast train connections to Europe; and using sustainable shipping through Bristol's port.

The website was promoted in a variety of ways, such as local events, networking and social media, targeted school visits and student projects. Today it is a basis for a number of other activities aimed at engaging different groups of citizens across the city.

Part 3 - Tools and services for regional innovation strategies in transport

Part 3 - Tools and services for regional innovation strategies in transport

In this section, we present some tools that can be used by regions in order to analyse their innovation activity and to compare with other European regions. The first section includes the tools coming out from the analysis that was conducted during the METRIC project. For more information and better understanding of the results, readers are encouraged to refer to the METRIC deliverables which are available here: <http://metricfp7.eu/conference/objective>.

The second section presents more general tools and services that can be used for regional innovation strategies.

METRIC Project tools

SWOT analysis

In METRIC deliverable 3.3 (Konings and Louw, 2014c) a SWOT analysis of selected regions of most EU countries is made. For each country a strong and weak performing innovation region were chosen and their strengths, weaknesses, opportunities and threats were described. The analysis suggests some commonalities in terms of regional strengths, weaknesses, opportunities and threats that may be helpful in the process of developing policies to improve the transport innovation potential of regions.

Regional innovation performance

Konings et al. (2014b) analyse the regional innovation performance, represented by innovation achievements, ranking regions in four categories according to their score in comparison to the European average (far above average, above average, below average and far below average). The variables considered to measure innovation achievements refer to proportion of innovative enterprises, number of patents, innovation activity of enterprises in terms of new products introduction and innovation-related output in terms of turnover from innovations. In the above cited report, authors also analyse the factors explaining regional innovation achievements, such as innovation milieu, innovation funding and the structure of the transport sector (each of these factors containing various indicators).

Regional innovation potential

Regional innovation potential is estimated in Hoppe and Winter (2014a). Following the Innovation Union Scoreboard and the Regional Innovation Scoreboard, NUTS-2 regions are analysed using different innovation-related variables, grouped in three categories, namely 'enablers', 'firm activities' and 'outputs'. The regions are further grouped in 3 socio-economic groups and comparisons between regions are performed within their socio-economic group. Finally an indicator on innovation potential is calculated for each NUTS2 region, by summing up the three innovation-related groups which allows a general ranking on transport innovation potentials.

Typology of regions

In Hoppe and Winter (2015b) a typology of European regions according to their transport innovation potential is presented. Ten type of regions are suggested which differ in economic situation, innovation in general and in the transport sector. These regional types are: New EU countries; Emerging economies; Recovering regions; South-mid Europe; French type; Smart and rising regions; Metropolitan regions; Old industrialized regions; Regions of economic structural change; Transport innovation regions.

The proposed typology could be used by regions in their Smart Specialisation Strategies, specifically for identifying competitive advantages as well as possible collaborations with similar regions.

Tool-box

A 'tool-box' useful for regions to take the most out of the analysis of innovation potential is presented in the last deliverable of work package 4 (Hoppe and Winter, 2015c). Available ready-to-use material can help regions identify their innovation type – the typology follows the classification of Hoppe and Winter (2015b) – and compare their innovation potential with other European regions under the same typology group or with the European average. Based on the information provided, specific strengths and weaknesses are identified and regions are advised about the main principles on which to focus during the strategic planning.

Benchmarking of regions

A benchmarking of regions was performed in METRIC deliverable 5.2 (Christodoulou, A. et al., 2015), using the indicators generated in Konings et al. (2014). Results show the highest scoring regions regarding innovation in the transport service sector and transport manufacturer sector.

This benchmarking exercise can be useful for analysing the regional context and the regional potential for innovation.

Regional innovation Scoreboard

The regional transport innovation scoreboard has its roots in the Innovation Union Scoreboard and the Regional Innovation Scoreboard. However, the choice of indicators is to a large extent affected by the availability of data, as the complete lack of data or the large amount of missing values for several variables did not allow their inclusion. The indicators considered (Table 6) are transport-specific, they are in detail described in Konings and Louw (2014a) and the majority of them have been used in the analysis in Konings et al. (2014b). Furthermore, the categorisation of Konings et al. (2014b) is adopted and the following indicators have been taken into account.

Table 6: Transport innovation indicators

<i>Categories</i>	<i>Indicators</i>
Achievements	Share of innovative enterprises 2010
	Share of highly innovative enterprises 2010
	Average number of patents per year (2006-2008) per 100.000 employees (2008)
	Share of enterprises that have introduced new or significant improved products that were new to the market (2010)
	Share of enterprises that have introduced new or significant improved products that were only new to the firm (2010)
	Share of turnover from innovations 2010
Economic performing	Growth (%) value added transport sector 2008-2011
	Growth (%) employment transport sector 2008-2011
	Growth (%) labour productivity transport sector 2008-2011
Sector structure	Average firm size 2010
	Share transport sector employment in total transport employment 2008
	Level of transport specialisation 2008
Funding	Share of product and/or process innovative enterprises that received any public funding 2008
	Public R&D as share of GDP 2008
	Business R&D as share of GDP 2008
	Share of government R&D spending on transport 2008
Innovation milieu	Transport research as share of total FP7 EC funding
	Cluster quality 2008
	Share of product and/or process innovative enterprises engaged in any type of co-operation 2008
	Share of employment in technology and knowledge-intensive sectors in transport services 2008 (NACE H and N79)

All the data are presented in the 'Scoreboard' area of the 'Transport Innovation Repository' which is available here: <http://fp7metric.sf.bg.ac.rs/index.html>. There, the user can select the countries/NUTS-2 regions, the innovation indicators distinguish between total transport, transport services and transport manufacturing. Results can be visualized in form of maps, tables or graphs (columns and spider graphs). The webpage also allows for simple calculations as well as to export the results in a excel sheet for further quantitative analysis.

Support provided by the Commission services and other institutions

Smart Specialisation Platform (S3P)

The Smart Specialization Platform is managed by the Joint Research Centre, Institute for Prospective Technological Studies. It provides assistance to countries and regions in their Smart Specialization process. The Platform provides policy support and information about EU funding programmes, methodological guidance, and expert advice. It also offers a set of useful tools such as:

- *Peer Reviews*: these are workshops that bring together regions and countries for mutual learning, focusing on best practices for the development and implementation of RIS3. Regions meet their peers, the European Commission staff, academic experts and other stakeholders to discuss common issues related to smart specialization. It also allows regions and countries to peer-review each other's work on RIS3.
- *Thematic Workshops*: The S3 platform supports the organization of thematic workshops on different themes that are of interest for RIS3. At least three regions should be part of or be presenting at an event. Several workshops were organized in the transport-related field such as one for intermodal transport, held in Las Palmas de Gran Canaria (ES). More information and documentation can be found at: <http://s3platform.jrc.ec.europa.eu/thematic-workshops>
- *Eye@RIS3*: is an online database that shows a realistic map of the process of RIS3 development, providing information on the priorities selected by regions. It helps other regions to find their unique niches and seek for potential partners. More information at: <http://s3platform.jrc.ec.europa.eu/eye-ris3>
- *Benchmarking Regional Structure*: this is an interactive tool that helps regions identify reference regions with similar structural conditions relevant for innovation-driven development. This information offers interesting lessons on the potential effects of policies and practices implemented in peers regions: <http://s3platform.jrc.ec.europa.eu/regional-benchmarking>
- *Stairway to Excellence (S2E)*: is a project that provides support to enhance the synergies between two key EU funding sources for research, development and innovation - ESIF and H2020. Special assistance is given to regions and countries that joined the EU since 2004, with the objective to close the innovation gap and increase participation of those regions and countries. Furthermore, it supports the implementation of national and regional RIS3. <http://s3platform.jrc.ec.europa.eu/stairway-to-excellence>

<http://s3platform.jrc.ec.europa.eu/home>

Know Hub

This Project collaborates with S3P by reviewing and improving the RIS3, built on experiences of 10 EU regions in designing and implementing smart and effective strategies for innovation. The website presents several tools that could be used, such as: smart encyclopaedia on regional innovation strategies and instruments; repository of good practice examples; blog and newsletter on important activities related to smart strategies and policy instruments within the EU; short videos lectures on regional innovation; and a library.

<http://www.know-hub.eu/>

Regional Innovation Scoreboard

The regional innovation scoreboard measures the innovation performance of 190 regions (NUTS2 level) from the EU, Norway and Switzerland. Regions are classified into four different innovation performance groups: innovation leaders; innovation followers; moderate innovators and modest innovators

<http://ec.europa.eu/enterprise/policies/innovation/policy/regional-innovation/>

ERAWATCH

ERAWATCH provides information on European, national and regional research systems, policies and programmes in the EU and beyond.

<http://erawatch.jrc.ec.europa.eu/>

Regional Innovation monitor Plus (RIM Plus)

The Regional Innovation monitor Plus (RIM Plus) provides detailed information on regional innovation policies for 20 EU Member States and some 200 regions. The information provided includes:

- An online 'inventory' of regional innovation policy measures, policy documents and organizations.
- Good practice dissemination on regional innovation policy in Europe.
- A network of regional experts with thematic specialisation and provision of Knowledge hub services.
- Organization of policy events.
- Communication platform for innovation stakeholders.

<http://ec.europa.eu/enterprise/policies/innovation/policy/regional-innovation/monitor/>

European Cluster Observatory

The European Cluster Observatory is an online platform that provides data and analysis of clusters, clusters organizations and regional microeconomic framework conditions in Europe. Furthermore it provides a cluster library and a classroom for cluster education. It also produces reports on clusters and regional competitiveness conditions.

<http://www.clusterobservatory.eu/index.html>

Transport Scoreboard

The Transport Scoreboard compares Member State performance in 22 transport-relevant categories and highlights the five top and bottom performers. It can be consulted either by transport mode (road, rail, maritime, air), by transport category or by country.

http://ec.europa.eu/transport/facts-fundings/scoreboard/index_en.htm

SME performance review

The SME performance review consists of two parts: 1) annual report on the economic performance of European SMEs and 2) national factsheets that improve the understanding of recent trends and national policies affecting SMEs. It provides information for EU Member States and 9 other partner countries.

http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/performance-review/index_en.htm

OECD

The OECD provides data and studies on regional development. Some examples are the 'Regional Outlook', the 'OECD Regional Well-being web tool', the 'Regional reviews of regional innovation' or the 'OECD Regional Database'.

<http://www.oecd.org/>

JASPERS (Joint Assistance to Support Projects in European Regions)

JASPERS provides advice to the 13 countries that joined the EU after 2004, as well as to Greece, the former Yugoslav Republic of Macedonia, Montenegro and Serbia during project preparation, to help improve the quality of major projects to be submitted for grant financing under the EU's Structural and Cohesion Funds.

<http://www.jaspers-europa-info.org/>

EURADA (European Association of Development Agencies)

EURADA runs conferences and seminars and produces several publications about EU policy developments on critical issues, such as state aid rules, funding as well as contract opportunities and partnerships.

<http://www.eurada.org/>

ERRIN

ERRIN is a network of research and innovation organizations and stakeholders in regions that aim to strengthen regional innovation capabilities by exchanging information, sharing best practices, supporting European project development and policy shaping. It is organized in 13 Working Groups, one of which is devoted to transport. The transport group focuses on identifying all funding and cooperation opportunities in the field of innovation related to transport among European programmes.

www.errin.eu

Conclusions

For EU regions and countries, the development of Smart Specialisation Strategies has become a prerequisite for applying for European Structural and Investment Funds (ESIF). Considering the demand for focused innovation plans, the provision of sector-specific recommendations for key economic sectors, such as transport, can offer significant help to regions (or countries) and most importantly improve the quality of the submitted RIS3 documents. The outputs of the METRIC project aim to help regions interested in focusing on transport innovation, in terms of providing assessment tools and planning guidelines.

In this report, the six steps for RIS3 are reviewed with a special focus on the transport sector. Additionally, recommendations for the development of RIS3 are presented in the form of roadmaps for the ten innovation fields that have been identified in the Strategic Transport Technology Plan (European Commission, 2012a)

Furthermore, evaluation tools summarising the outputs of previous METRIC work packages and other general tools and services are presented in section 3 and offer relevant information for the process of Smart Specialisation Strategies.

In summary, this report can help regions or countries to a) define specific transport RIS3 priorities using a six-step strategy guide, b) position themselves on transport innovation maps structured around ten innovation areas, c) evaluate their innovation status and potential using tools and services provided in this guide.

References

Aerospace and Defence Industries Association of Europe (ASD) (2014). Facts and figures 2013. ASD Communication and Information Team. Brussels

Christodoulou, A., Christidis, P., Condeço-Melhorado, A. (2015) Development of innovation roadmaps. METRIC FP7 project. D5.2.

Christodoulou, A. and Finger, M. (2012). The governance of urban public transport systems: the case of Zurich (ZVV). Regional Studies Association European Conference 2012, Delft University of Technology, Netherlands, 13-16 May 2012.

Condeco-Melhorado, A. (2014). Guide on regional transport innovation strategies. METRIC Deliverable 5.1.

ERTRAC (2010). ERTRAC Strategic Research Agenda 2010. Towards a 50% more efficient road transport system by 2030.

European Commission (1995). Directive 95/46/EC of the European Parliament and of the Council on the protection of individuals with regard to the processing of personal data and on the free movement of such data. Official Journal, L 281.

European Commission (2002). Directive 2002/58/EC of the European Parliament and of the Council of 12 July 2002 concerning the processing of personal data and the protection of privacy in the electronic communications sector (Directive on privacy and electronic communications). Official Journal, L 201.

European Commission (2009a). Communication from the commission to the European parliament, the council, the European economic and social committee and the committee of the regions: Action Plan on Urban Mobility. COM(2009) 490 final.

European Commission (2009b). Directive 2009/28/EC of the European Parliament and of the Council. Official Journal of the European Union, L 140/16.

European Commission (2010). DIRECTIVE 2010/40/EU of the European Parliament and of the Council on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport. L 207/1.

European Commission (2011a). White Paper – Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system. COM(2011) 144 final.

European Commission (2011b). Commission Staff Working Document - Accompanying the White Paper. SEC (2011) 391 final.

European Commission (2011c). Commission Staff Working Paper – Impact Assessment –Accompanying document to the White Paper. SEC (2011) 358 final.

European Commission (2011d). Flightpath 2050 - Europe's Vision for Aviation - Report of the High-Level Group on Aviation Research. Belgium, ISBN 978-92-79-19724-6.

European Commission (2012a). Communication from the Commission to the Council and the European Parliament: Research and innovation for Europe's future mobility – Developing a European transport-technology strategy. COM(2012) 501 final.

European Commission (2012b). Commission Staff Working Document – Preliminary Descriptions of Research and Innovation Areas and Fields – Accompanying the document – Communication – Research and Innovation for Europe's Future Mobility. SWD(2012) 260 final.

European Commission (2013a) Report on Synergies between the Transport component of Horizon 2020 and the Cohesion Policy 2014-2020. European Union.

European Commission (2013b). LeaderSHIP – The Sea: New Opportunities for the Future. Report available here: http://ec.europa.eu/enterprise/sectors/maritime/files/ship_building/leadership2020-final-report_en.pdf

European Commission (2014a). The Digital Agenda Toolbox. Joint Research Centre, Institute for Prospective Technological Studies. Luxembourg: Publications Office of the European Union. EUR 26459 EN

European Commission (2014b). EU transport in figures – Statistical Pocketbook 2014. Belgium, ISBN 978-92-79-37506-4.

European Commission (2014c). Enabling synergies between European Structural and Investments Funds, Horizon 2020 and other research, innovation and competitiveness-related Union programmes. Luxembourg: Publications Office of the European Union. ISBN: 978-92-79-38599-5

European Commission (2012). Guide to research and innovation strategies for smart specialization (RIS3). Publication Office of the European Union: Luxembourg.

Foray, D. (2015). Smart Specialisation: Opportunities and Challenges for Regional Innovation Policy. Abingdon; New York: Routledge.

Hoppe, M. and Winter, M. (2014). Matrix of main principles for regional transport innovation. METRIC Deliverable 4.1.

Hoppe, M. and Winter, M. (2015a). Typology of regions concerning transport innovation. METRIC Deliverable 4.2.

Hoppe, M. and Winter, M. (2015b). “Tool-Box” for adapting success factors for innovation on a regional level. METRIC Deliverable 4.3.

International Transport Forum (2012). Statistics Brief – Infrastructure Investment. OECD

Konings, R. and Louw, E. (2014a). Transport innovations indicators. METRIC Deliverable 3.1.

Konings, R. and Louw, E. (2014b). Transport Innovation SWOT-analysis. METRIC Deliverable 3.3.

Konings, R., Louw, E. and Meijers, M. (2014). Transport research and innovation performance of regions. METRIC Deliverable 3.2.

OECD – Organisation for Economic Co-operation and Development (2013). Innovation-driven Growth in Regions: The Role of Smart Specialisation – Preliminary Version.

Sörvik, J. Kleibrink, A. (2014) The Digital Agenda Toolbox. Institute for Prospective Technological Studies. Joint Research Centre. Retrieved from <https://ideas.repec.org/p/ipt/iptwpa/jrc88896.html>

Sörvik, J. Kleibrink, A. (2015) Mapping Innovation Priorities and Specialisation Patterns in Europe. S3 Working Paper Series. No 08/2015.

TECHNOPOLIS GROUP & MIOIR (2012): Evaluation of Innovation Activities. Guidance on methods and practices. Study funded by the European Commission, Directorate for Regional Policy

Union internationale des chemins de fer (UIC) and Union des Industries Ferroviaires Européennes (UNIFE) (2011). Towards 2030 – Noise and vibrations roadmap for the European railway sector. ERRAC Roadmap – WP01 – Greening of Surface Transport.

United Nations, Department of Economic and Social Affairs, Population Division (2014). World Urbanization Prospects: The 2014 Revision, Highlights (ST/ESA/SER.A/352).

Wiebe, E.; Chéron, C.; Walter, M.; Sandor, J. (2011). Energy Roadmap for the European Railway sector, ERRAC Roadmap – WP01 – Greening of Surface Transport.

Wiesenthal, T.; Leduc, G.; Cazzola, P.; Schade, W.; Köhler, J. (2011). Mapping innovation in the European transport sector - An assessment of R&D efforts and priorities, institutional capacities, drivers and barriers to innovation. JRC Scientific and Technical Reports, European Commission. EUR 24771 EN.

Wiesenthal, T.; Condeço-Melhorado, A.; Leduc, G. (2015) Innovation in the European transport sector: A review. *Transport Policy*, 42, 86-93.

Europe Direct is a service to help you find answers to your questions about the European Union
Freephone number (*): 00 800 6 7 8 9 10 11

(*): Certain mobile telephone operators do not allow access to 00 800 numbers or these calls may be billed.

A great deal of additional information on the European Union is available on the Internet.
It can be accessed through the Europa server <http://europa.eu>.

How to obtain EU publications

Our publications are available from EU Bookshop (<http://bookshop.europa.eu>),
where you can place an order with the sales agent of your choice.

The Publications Office has a worldwide network of sales agents.
You can obtain their contact details by sending a fax to (352) 29 29-42758.

European Commission

EUR 27502 EN – Joint Research Centre – Institute for Prospective Technological Studies

Title: Smart guide on regional transport innovation strategy

Authors: Ana Condeço-Melhorado, Aris Christodoulou, Panayotis Christidis
Luxembourg: Publications Office of the European Union

2015 – 85 pp. – 21.0 x 29.7 cm

EUR – Scientific and Technical Research series – ISSN 1831-9424 (online)

ISBN 978-92-79-52294-9 (PDF)

doi:10.2791/34368

JRC Mission

As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new methods, tools and standards, and sharing its know-how with the Member States, the scientific community and international partners.

Serving society
Stimulating innovation
Supporting legislation

doi:10.2791/34368

ISBN 978-92-79-52294-9

