Project ID: 265841

Transport Research Market Uptake (Market-up)

Deliverable 5.1

Recommendations for a better market uptake of transport results and involvement of actors

Lead partner: TIS

Consortium:

- TIS (PORTUGAL) - Co-ordinator
- CLEPA (BELGIUM)
- EMEC (BELGIUM)
- FRAUNHOFER (GERMANY)
- BME (HUNGARY)
- INOVA+ (PORTUGAL)
- UNIZA (SLOVAKIA)
- UA (BELGIUM)
- INNOVA (ITALY)

Project co-funded by the European Commission within the Seventh Framework Programme

Due Date of Deliverable: 30/09/2012 Completion Date of Deliverable: 01/10/2012	Start Date of Project: **1 October 2010** Duration: **24 Months**

Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Foreword

This document corresponds to the final technical report of the FP7 Market-up project, presenting its conclusions and recommendations being prepared by TIS with inputs from partners

This document is set to be Public (PU), and should be referenced as:

Market-up consortium (2012), **"Recommendations for better market uptake of transport results and involvement of actors - Deliverable 5.1",** Market-up project, funded by the European Commission under the 7th FP.
or
Carvalho D, Vieira J, Köhler J, Pauwels T., Fabian. P, Bravo C., Szendro, G, Cunningham D., Hedlund B, Macek P., Rofar J., Thedieck B., Vanelslander T. (2012), **"Market-up, Recommendations for better market uptake of transport results and involvement of actors - Deliverable 5.1",** Market-up project, funded by the European Commission under the 7th FP.

QUALITY CONTROL INFORMATION:

Version	Date	Description
1	01-06-2012	1st outline of recommendations (for discussion in Rome)
2	13-09-2012	1st complete draft
3	20-09-2012	Updated version after Porto meeting
4	26-09-2012	Draft final version for Quality Control
5	29-09-2012	Final version after QC
6	05-10-2012	Final version submitted

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

Table of Contents

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

Table of Figures

Index of Tables

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

Market-up Key Messages

1. Across the main global economic blocks (e.g. European Union, Japan, USA), public investment in research, development and innovation (RDI) is relatively stable, ranging between 0.65% to 0.78% of GDP (0.74% in the EU). However, private investment in general in RDI does vary substantially between regions and the underinvestment in the private sector in Europe is identified as a weakness of the European research and innovation system. However, this general picture is not reflected in the specific case of transport, where private investment amounts for more than 90% of the estimated total transport RDI effort and where European companies invest far more than foreign competitors. Accordingly, lack of investment from the private sector does not seem to be a weakness of the European transport research and innovation system.
2. There are substantial differences in the investment in RDI across the EU-27. The total investment in RDI as share of GDP, the data on the participation on European-funded research activities and the dominant share few companies of corporate RDI investment all suggest that while the volume of corporate investment in R&D does not appear to threaten research and innovation capabilities in transport, its concentration can prove to be a weakness.
3. It is difficult to identify the key players on transport research and innovation on a given topic. Information systems in place, such as the NCPs network or the Transport Research Innovation Portal (TRIP, previous TRKC), fail to allow a straightforward identification of key players and relevant competences across the EU. Such absence of effective and independent information sources can make it potentially difficult for potential newcomers to get to know who is working in which field and accordingly pool resources with them and join competitive proposals.
4. EU funding programmes, such as the FP7, play an important role in building up competences for transport research across Europe, but the presence of national research funding programmes, complementary or additional to the European

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

programmes, is key to achieve high levels of capacity on transport research and innovation.

5. The analysis of transport related funding instruments provides evidence for the existence of the "valley of death", i.e. a funding gap at an intermediate stage of the innovation process, between basic research and commercialization of a new product. It seems easier to find research funding mechanisms for the phases of basic or applied R&D and demonstration than for the market pull phases of commercialization, market accumulation or diffusion. Moreover, most funding schemes analysed showed little focus on financing closer-to-market activities, market analysis and development plans.
6. Most funding instruments analysed in Market-up are oriented towards engaging industrial partners, research organisations and/or education institutions in collaborative projects. Many of them have specific provisions to ease the involvement of SMEs and a trend towards increased use of these provisions was identified. This is important as a mechanism to involve weak players in transport research and can potentially play a prominent role in increasing the market uptake of research results.
7. A great effort needs to be made to achieve the objective of orienting European R&D investment towards addressing societal challenges. In FP7 there seems to be an unbalanced investment split across modes, in which air transport appears to be benefiting from a high proportion of R&D investment while cross-modal issues, which are critical to achieve "smart, green and integrated transport" seem to be underfinanced.
8. Both the mapping of competences and the identification of funding instruments are key deliverables of the Market-up project. Since comprehensive data sources do not exist, there is a need to develop such activity in more detail, however the experience with Market-up suggests that such effort should be done in a way that allows for easy and frequent update of these results as such aspects are continually evolving.

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

1. Introduction

This document presents the results of the Work Package 5 (WP5) of the Market-up project. As indicated in the Description of Work (DOW) WP5 aimed to formulate specific policy recommendations on potential for improving uptake of innovation in the transport sector, focusing in particular on research results and technologies and involvement of innovation actors (encouraging weak players).

The work was divided in three tasks: the first focus on Market-up conclusions on the context of R&D funding actions, the second on the lessons learnt on research funding instruments in transport and a third with the recommendations for better market uptake of transport research results and involvement of stakeholders, in particular SMEs. Although, as described in the next Chapter, important changes in the policy framework were introduced during the development of Market-up, this document maintains this structure and accordingly has three key chapters focusing on the context of R&D funding (Chapter 4), the research funding instruments (Chapter 5) and on policy recommendations (Chapter 6). In addition to these chapters there is one introductory section addressing the policy background (Chapter 2) and another describing the methodology employed in developing the work (Chapter 3).

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

2. Policy background

The policy framework under which the Market-up project is being developed evolved substantially since the submission of the proposal and adoption of the DOW. In March 2010 the European Commission presented the **"Europe 2020" strategy** (EC, 2010) and, as a key part of such strategy, in October, just a few days after the official kick-off of Market-Up activities its **Flagship Initiative "Innovation Union"** was announced, aiming to *improve framework conditions and access to finance for research and innovation so as to ensure that innovative ideas can be turned into products and services that create growth and jobs* (EC, 2010a).

This **Innovation Union Communication** has a substantial impact on the work of Market-up. First because it presents the strategy and the commitments of the European Commission that will frame the European research and innovation policy until 2020. And second because it broadly recognises some of the premises that sustain the work of Market-up: the need to get more innovation out of research and to enhance the cooperation between the worlds of business and science; the urgency to remove barriers for entrepreneurs to bring "ideas to the market", including through better access to finance for SMEs and the commitment to launch European Innovation Partnerships which will aim to accelerate research, development and market deployment of innovations to tackle major societal challenges. Amongst other aspects the Communication notes that *during the technology transfer and start-up phase, new companies face a "valley of death" where public research grants stop and it is not possible to attract private finance* (EC, 2010a).

Developments within the European Transport Policy were also relevant. The adoption in 2011 of a new **White Paper on Transport Policy** is a major milestone (EC, 2011), being in line with the flagship initiative "Resource efficient Europe", also set up in the Europe 2020 Strategy. The White Paper recognizes the importance of the development and deployment of new technologies and innovative transport systems in achieving the objectives of the European Transport Policy. Moreover it commits the European Commission to *devise an innovation and deployment strategy for the*

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

transport sector, in close cooperation with the Strategic Energy Technology Plan (SET-plan), identifying appropriate governance and financing instruments, in order to ensure a rapid deployment of research results (EC, 2011).

Another key policy development occurred later in 2011, when the European Commission adopted a **Communication on the "Horizon 2020"**, the new master programme to finance research and innovation in the EU, which will now concentrate all existing Union research and innovation funding (EC, 2011a). Amongst the *key novelties* introduced with Horizon 2020 we underline three which focus on improving the market uptake of research results:

- The integration of research and innovation by providing seamless and coherent funding from idea to market;
- More support for innovation and activities close to the market, leading to a direct economic stimulus;
- A strong focus on creating business opportunities out of our response to the major concerns common to people in Europe and beyond, i.e. 'societal challenges';

In addition to these *novelties*, improving the market uptake of research results is also mentioned in the presentation of the three *key priorities* of Horizon 2020. The first priority - Excellent Science - focuses on raising the level of excellence in Europe's science base and ensuring a steady stream of world-class research to secure Europe's long-term competitiveness. In the second key priority – Industrial Leadership – access to risk financing and support for SMEs are noted as areas where increased activities will be undertaken. For the third priority – Societal Challenges – Horizon 2020 will cover activities from research to market with a new focus on innovation-related activities, such as piloting, demonstration, test-beds, and support for public procurement and market uptake. This is then reflected in the budget that will prioritise spending with immediate impact on growth and jobs through major investment in risk finance, SMEs and large scale pilots and demonstrators for key technologies. Another aspect that is addressed in the preparation of Horizon 2020 is the simplification of access to EU research and innovation funding. The FP7 interim evaluation report concluded that major steps towards further simplification were

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

needed (EC, 2010b), and the Commission proposed substantial changes in this field in the hope of making the programme more attractive and inclusive for researchers and to industry.

All in all, Horizon 2020 is intended to give stronger support to the market take-up of innovation. This will include more proof-of-concept, piloting and demonstration. It will involve a better use of the potential of research infrastructures, as well as setting technical standards, pre-commercial procurement and strengthened loan and equity financing. It also aims to further involve SMEs in research and innovation activities. The Communication notes that *SMEs have significant innovation potential and they have the agility to bring revolutionary technological breakthroughs and service innovation to the market* (EC, 2011a) and an integrated approach is proposed to engage SMEs in Horizon 2020: increased simplification, a new SME specific instrument, a dedicated activity for research-intensive SMEs and improved access to risk financing.

Two important aspects for which relevant developments are expected in short and medium term regard the completion of the **European Research Area** (ERA) and the **Strategic Transport Technology Plan** (STTP). For the ERA the aim is to build a genuine single market for knowledge, research and innovation, enabling researchers, research institutions and businesses to circulate, compete and co-operate across borders. In the *Innovation Union* Communication the European Commission has committed to deliver the ERA before the 2014 deadline. Regarding the STTP, the European Commission issued a public consultation in May 2011 and in its report it notes that *the STTP, which should be finalised by the autumn 2011, will outline priorities for transport research and innovation areas, in this report also referred to as technology areas* (EC, 2011b). By the end of September 2012, just few days before the conclusion of this deliverable the STTP communication was launched. In this communication, three initial Research and Innovation areas (R&I areas) and, within these areas, ten fields with a clear EU added value on which research and innovation (R&I) should focus were identified, being those considered

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

as having significant potential for helping achieve the White Paper's objectives by 2030 — or by 2050. [1]

All these developments impact the work of Market-up, particularly its policy recommendations. First, it places the issue of market uptake at the heart of policy discussions on the European research policy for the future. Second, it puts forward a set of proposals, framing a roadmap on how to improve the market uptake of research results. Accordingly, in its policy recommendations Market-up does not need to demonstrate the concepts behind its proposal, which are now rather *universally* accepted by policy makers[2]. Similarly instead of developing a roadmap independent from the one the European Commission is presenting, Market-up will look to the European Commission roadmap and comment on the scale of the challenge to address the weaknesses and challenges identified throughout the project.

[1] The fields identified refer to 3 R&I areas and 4 cross cutting themes: R&I clean, safe, efficient silent and smart transport means, R&I of infrastructure &smart systems; R&I of transport services and operations for passengers and freight. Cross cutting technologies and issues stretch along the three R&I areas include: ICT, safety and security, Energy and energy efficiency improvement technologies and Socio-economic issues. Focus on alternative fuels, solutions related to infrastructure usage covered by Market-up case studies address fields covered by the STTP communication.

[2] For example, in its Resolution on the Innovation Union Flagship Initiative the European Parliament (EP) *takes the view that the commercial exploitation of research findings in the EU is inadequate or too slow*; then it calls, for example, *on the Commission to link funding instruments more closely to demand-side innovation tools and to direct this support in greater extent to SMEs and start-up companies* and *recommends a change of the EIB mandate to allow for financing of risk-intensive close-to-the-market research and innovation* (EP, 2011). The Council also notes *closer links are needed between R&D, innovation, societal needs and the market, to promote innovation and the rapid development and commercialisation of research results and of key technologies* and *considers access to finance for all forms of innovation, notably for SMEs, as a top priority for action* (Council of Ministers, 2011).

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

3. Methodology

The objective of Work Package 5, to summarize conclusions from the project and to produce a set of policy recommendations, means that its development should be based on a thorough review of the previous work packages and on discussions between all partners involved and relevant stakeholders. The methodology applied in developing Work Package 5 is presented in the Figure below.

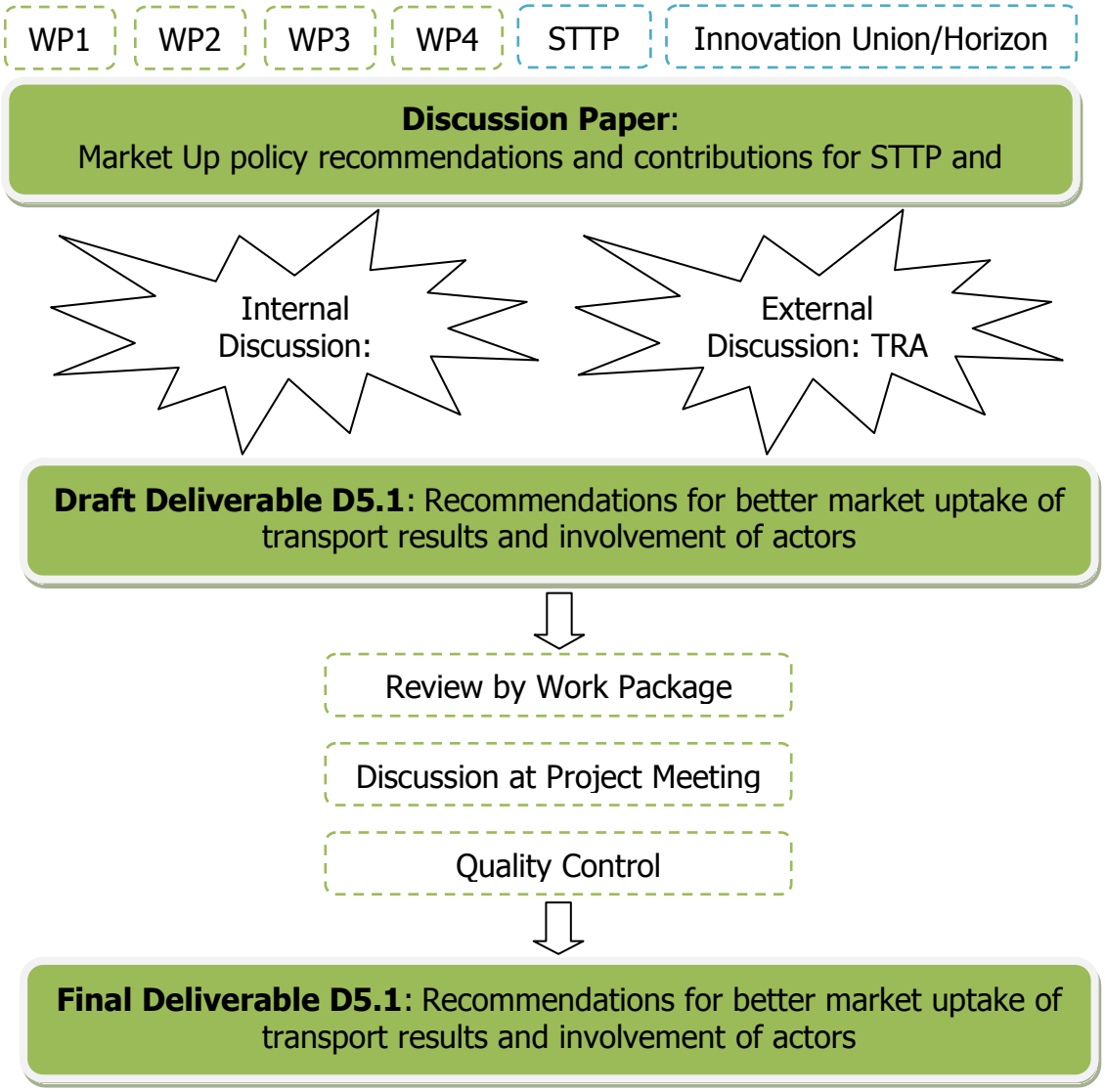

Figure 1: Overview of the methodology to develop market-up conclusions and policy recommendations

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

In summary the first step was to review the work undertaken in Market-up's various work packages and the recent developments in European transport research and innovation policies to produce a discussion paper with a set of thought-provoking ideas for conclusions and policy recommendations. This document was then discussed internally and externally: amongst all partners in a project meeting (held in Rome in May 2012) and with key stakeholders on transport research and innovation on a parallel session organised in the Transport Research Arena (held in Athens in June 2012). In TRA the relevance of the topic of market uptake of transport research was particularly evident, being discussed not only in this session but also in many others. Amongst others, discussions addressed the role of SMEs and the best ways to encourage higher participation of innovative SMEs in the research programmes. Issues such as reducing bureaucracy and simplification or the need to have more structured support to potential newcomers were also discussed.

Based on the outcomes of this internal and external discussion the Work Package leader prepared a draft version of the Deliverable and requested for general and specific contributions from all Work Package leaders. An updated version of the document was then presented and discussed with all partners in the final project meeting (held in Porto in September 2012). From this discussion a final version of the deliverable was prepared and subjected to quality control before final submission to the European Commission.

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

4. Context of R&D funding

The analysis of the context of transport R&D and innovation in Europe was the main purpose of Work Package 2, although this issue was also touched upon in other parts of Market-up. In Work Package 2, a detailed assessment of participation in FP7 projects was undertaken, followed by a country and mode specific application of the Sectoral System of Innovation (SSI) approach to characterize the context, identify the actors and analyse funding sources in each country of the EU-27. This country-specific analysis was then to be validated by all National Contact Points (NCPs) although the level of response was not satisfactory. Still, through the analysis of the participation in FP7 projects and the desk research on the framework, the actors and the funding instruments in all countries, relevant information on the context under which transport research and innovation takes place in the EU-27 was produced.

This work gave important conclusions for policy makers aiming to improve their understanding of the characteristics of transport research in Europe and who are putting in place or revising new instruments to increase the market uptake of transport research. These conclusions are summarized in the next two sections. The first takes an overview of R&D investments in Europe and identifies patterns in the participation in FP7 programmes where specific information on transport can be obtained. The second section summarizes relevant insights that result from the mapping of competences that was performed in the framework of Market-up Work Package 2.

4.1. R&D investments in Europe and participation in Transport FP7 activities

The European Commission presents a thorough overview of R&D efforts in Europe in the 2011 edition of its Innovation Union and Competitiveness Report (EC, 2011c).

One of its main indicators measures the achievement of the 3% R&D investment target, as investment in research and innovation is a key driver of growth and innovative ideas for the future of Europe. According to the report, during the period

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

2000-2007, the EU R&D intensity stagnated as a result of a parallel increase in GDP and Gross Expenditure on R&D (GERD). More recently, EU R&D intensity has grown from 1.85% of GDP in 2007 to 2.01% in 2009 as the result of a decrease in GDP and widespread budgetary prioritisation of public R&D funding combined with the resilience of private investment in R&D. Between 1995 and 2008, total research investment in real terms rose by 50% in the EU. However, performance was higher in the rest of the world, as the world economy became more knowledge-intensive (EC, 2011c). Figure 2 represents the share of GDP invested in R&D in the various European countries.

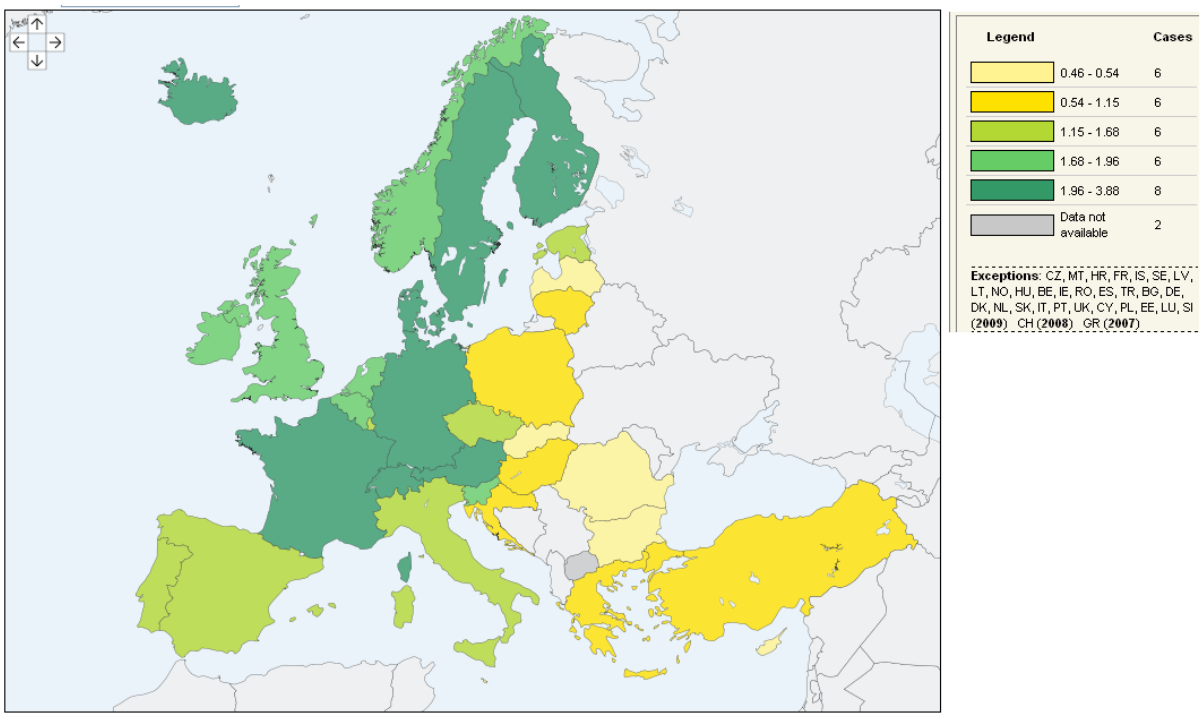

Figure 2: Research and development expenditure, as % of GDP [Source: Eurostat, 2011]

As it can be seen there are substantial differences across Europe, which are exacerbated if the level of analysis is further detailed to consider regional expenditure. This is certainly important in terms of market uptake, as less investment in R&D is surely reflected in the capacity to attain better results in research phases and then to ensure their successful penetration in the markets. However, it is also important to understand how much of this investment is promoted by the public sector and how much derives from industry and business, as these are much more

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

likely to focus their R&D efforts in marketable products and services. The conclusions from the Commission analysis in the Innovation Union and Competitiveness Report are very clear: the EU under-investment in R&D is most visible in the business sector where Europe is falling further behind the United States and the leading Asian economies (EC, 2011c).

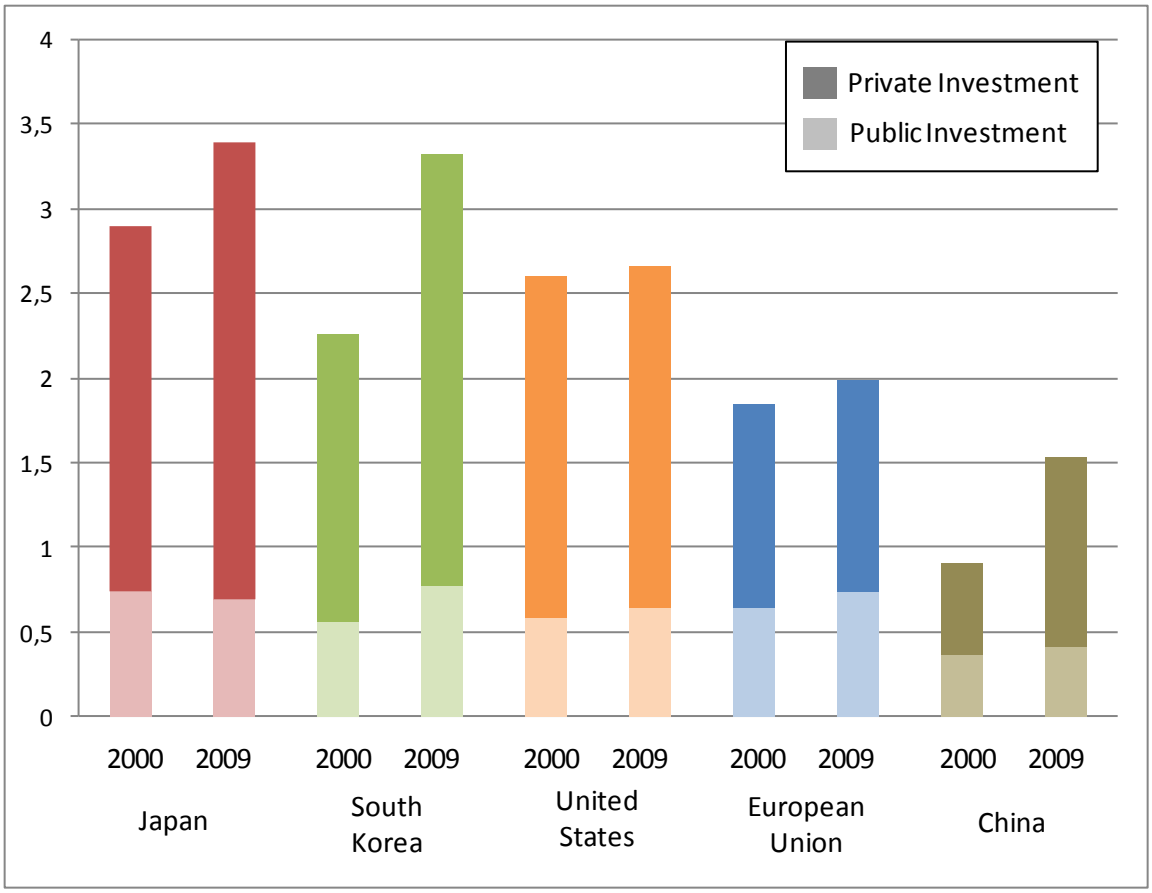

Figure 3: Public and Private R&D expenditure as % of GDP, 2000 and 2009 [Source: Market up, based on data from EC, 2011c]

The Figure shows the contribution of public and private bodies for R&D expenses in several world blocs. The first conclusion that emerges regards the relatively minor differences across countries in the investment in public R&D: with the exception of China, public R&D investment in 2009 varies between 0.65% of GDP in the United States and 0.78% of GDP in South Korea (i.e. less than 0.15%). What really makes the difference between these trading blocs is the volume of private investment in R&D and that is where Europe is falling behind, with 1,25% of GDP in 2009 against 2.01% in the United States, 2.54% in South Korea and 2.70% in Japan. Another

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

interesting element to consider is that investment in R&D is increasing at much higher rates in the Asian countries than in Europe and the United States.

As a result from these trends the Innovation Union and Competitiveness Report has listed the underinvestment in Research and Education, especially in the private sector, as a weakness of the European research and innovation system (EC, 2011c).

This is well reflected in the assessment of indicators on the Innovation Union Scoreboard (IUS) that are available for comparison at international level.

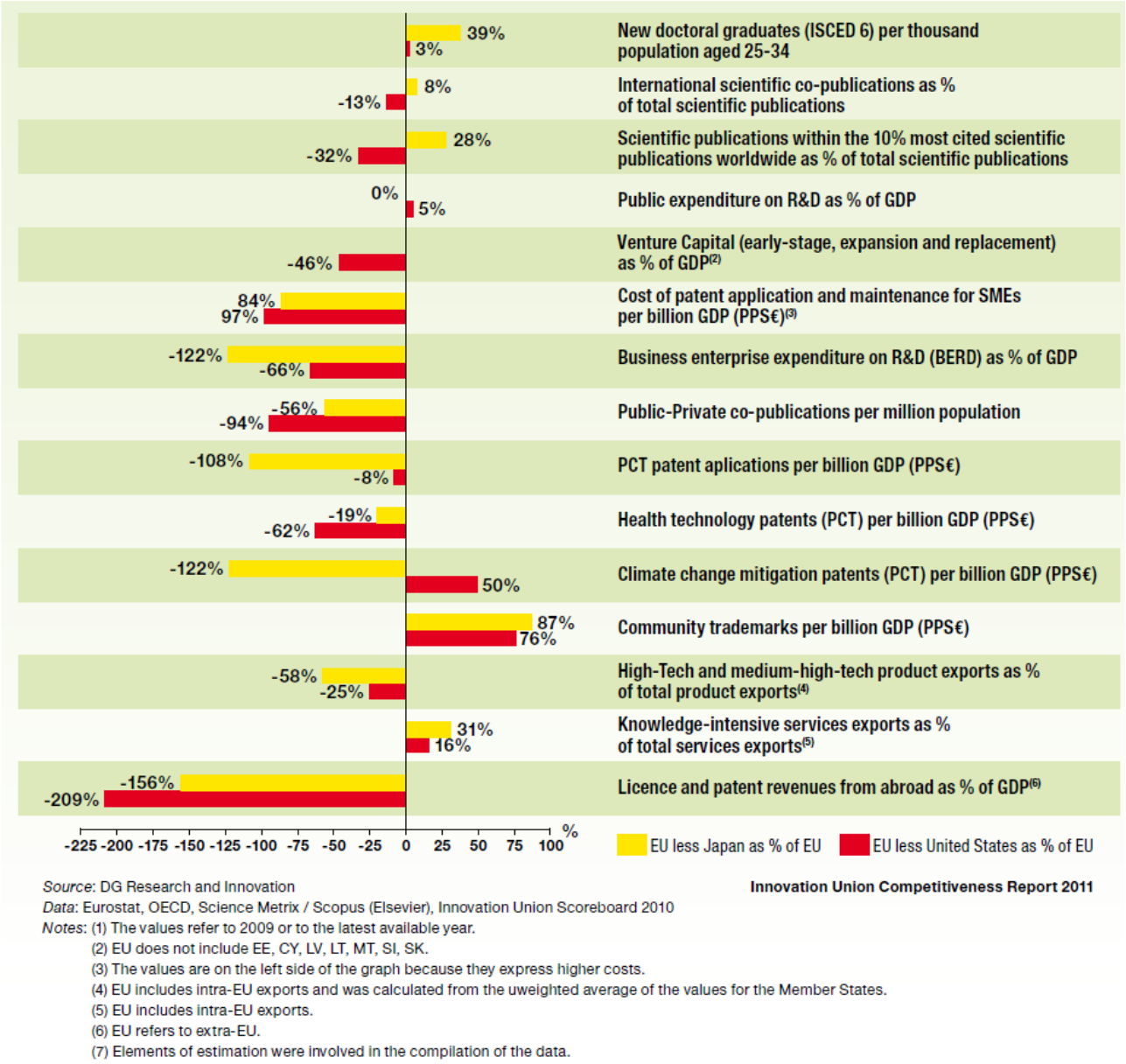

Figure 4: Performance Scoreboard for Research and Innovation indicators - The gap between the EU and the United States and Japan, 2009 [Source: EC, 2011c]

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

While the two indicators strongly related with the education system (e.g. doctoral graduates) or with public expenditure on R&D are rather positive when compared with performance in the USA or Japan, the indicators more related with private research (e.g. business expenditure in R&D), entrepreneurship (e.g. venture capital) or patent applications (e.g. licence and patent revenues from abroad) generally the EU falls well behind performance in competing blocks.

In general we can conclude that Europe remains a global leader in R&D but its position is increasingly at risk, especially since its companies seem to be underinvesting in R&D while in Asia the opposite is occurring. In addition it is worth noting that major differences exist within Europe, where Northern European countries appear to concentrate much more investment in R&D than in South and Eastern European Member States.

This creates a good picture, supported by strong evidence, of the overall framework conditions for research and innovation in Europe. However, Market-up wanted to analyse in more detail the framework conditions within transport, notably to verify whether this general picture also applies to the transport sector as well as understanding if there are there transport specific aspects related with the framework conditions for research and innovation which suggest that attention should be paid to particular aspects.

One initial aspect that emerges from the overall assessment of the framework activities regards the differences that exist amongst Member States in their investment in transport research and innovation. Given that data that is sufficiently accurate to determine transport R&D investment per country is not available, the Market-up approach was to compare the participation of different Member States in transport related FP7 calls. The Figures below present the most relevant results obtained.

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

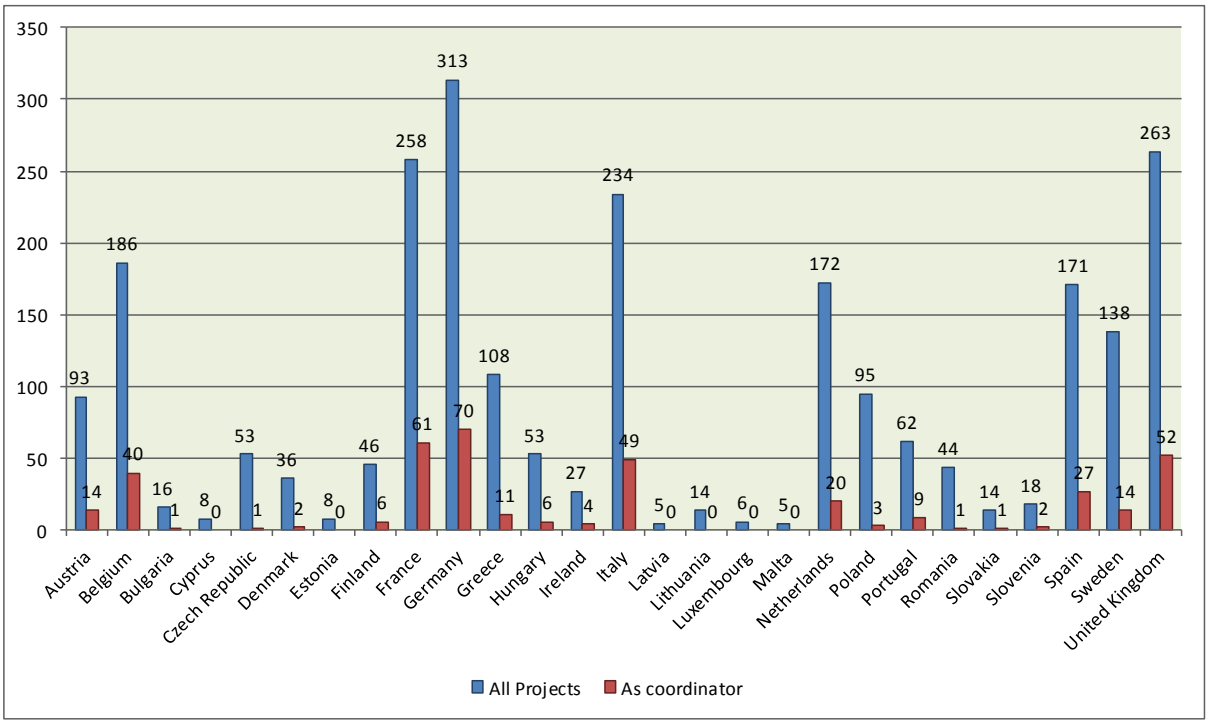

Figure 5: Numbers of transport FP7 projects
[Source: CORDIS Database on FP7 projects]

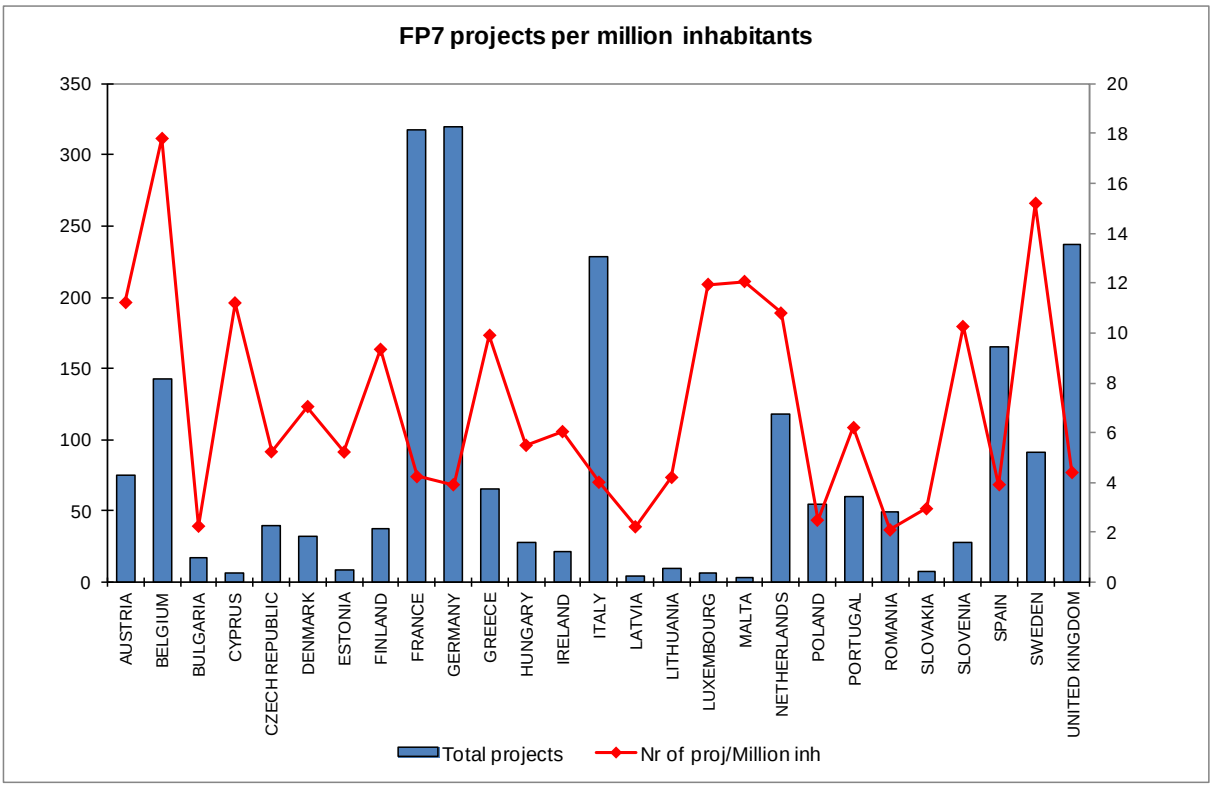

Figure 6: FP7 projects per million inhabitants
[Source: CORDIS Database on FP7 projects]

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

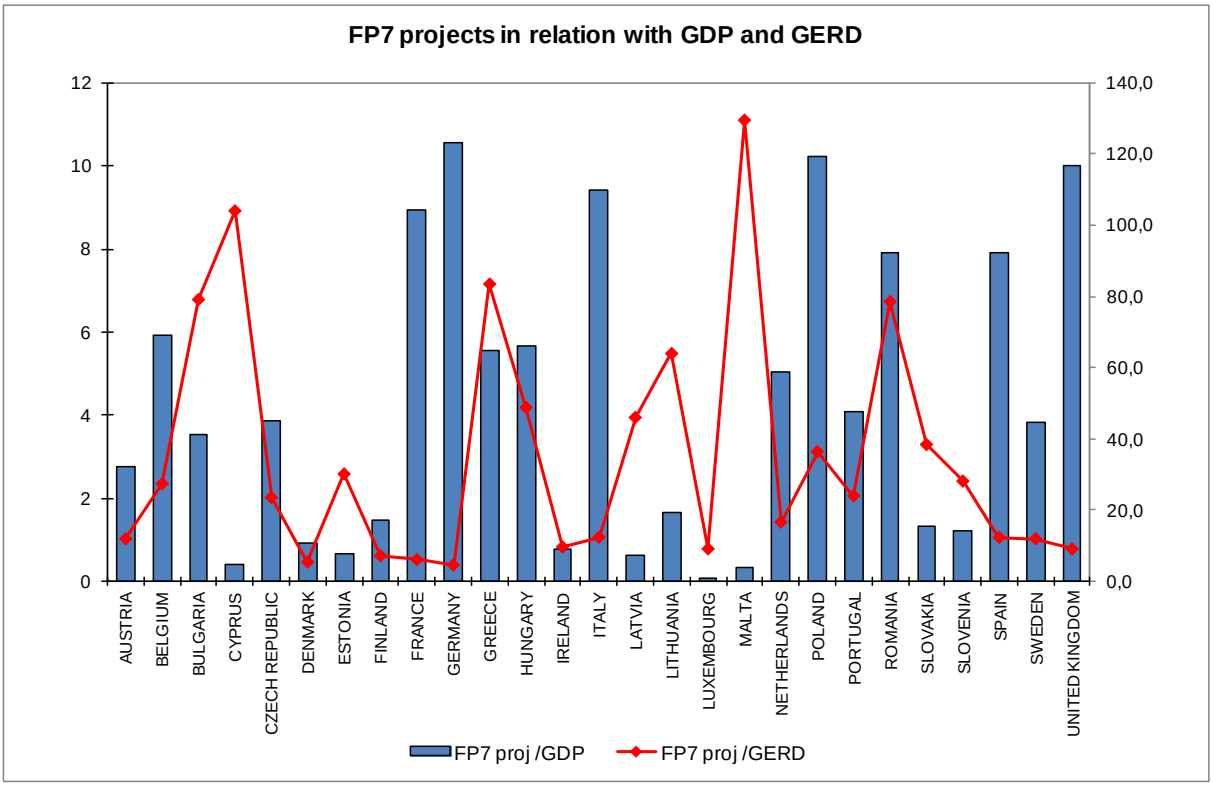

Figure 7: FP7 projects in relation to GDP and GERD
[Source: CORDIS Database on FP7 projects]

As one can see from Figure 5 the only four Member States with more than 200 participations in transport FP7 projects are Germany, the United Kingdom, France and Italy. If we take account of participations per million inhabitants Belgium ranks the highest, although that may result from the fact many associations based in Brussels participate in FP7 as Belgium undertakings. Luxembourg, Cyprus and Malta also have high values but that may reflect their relatively low number of inhabitants. From the remaining countries with above average results – Sweden, Austria, Greece, Finland and Slovenia – only one (Greece) has a relatively low level of R&D investment per unit of GDP (see also Figure 2). The analysis per unit of GDP confirms Germany, the United Kingdom, France and Italy as key players, while it also shows Spain Romania and Bulgaria as important Member States. All in all, **we can conclude that this analysis seems to show that within transport strong differences exist in terms of R&D investment across the EU**. The "big" four European Member States are the most important players, while for example, 6 Member States did not coordinate any FP7 project. Still a few countries, such as

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

Sweden, Austria, Greece, Finland, Slovenia, Spain Romania and Bulgaria appear to perform well when we consider their population and/or GDP.

Regarding the split between public and private R&D investment, Figure 8 presents the results obtained in the GHG TransporD project.

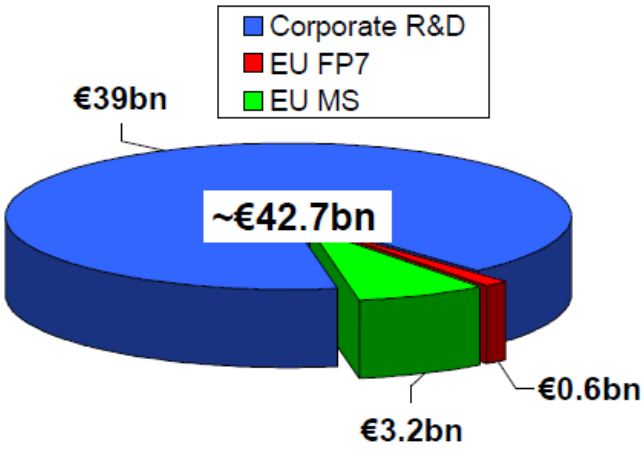

Figure 8: Public and corporate R&D investment in transport in the EU (2008) [Source: Leduc, *et al*, 2010]

The Figure 8 shows that the vast majority of transport R&D investment in Europe originates in business investment, which amounts for more than 90% of the estimated total. This differs substantially from the general situation, as across all areas the private investment in R&D in Europe represents about 63% of the total. Accordingly we can conclude that **in the transport sector the private investment in R&D represents a substantially higher share than in other sectors**.

These results probably reflect the fact that European transport companies invest relatively more than 'foreign' counterparts in R&D. The Figure below presents an overview of transport companies investment in R&D in different regions of the world, showing that in 2008 Europe was clearly ahead all competitors.

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

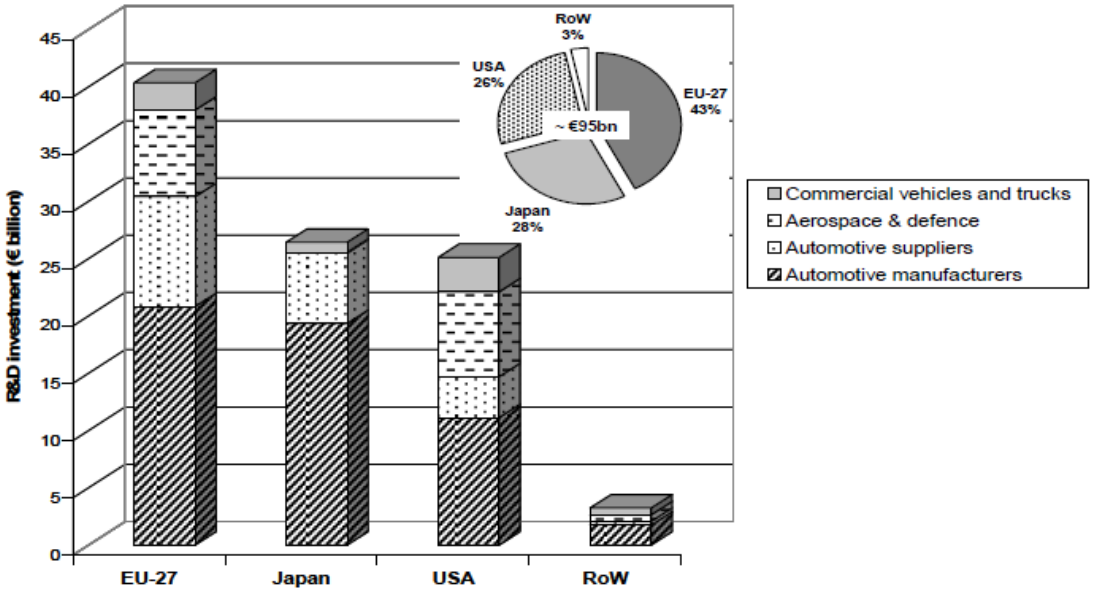

Figure 9: Distribution of R&D investments from transport-related companies worldwide (2008)
Source: EU Scoreboard 2009 (DG RTD, 2009)

It is evident the role of the automotive industry in shaping this pattern, as automotive manufacturers and suppliers in Europe spent a higher budget in R&D in 2008 than the entire transport budget in all other regions in the world. In the case of aerospace and defence European countries are also amongst the bigger players, although companies in the United States seem to be investing more than those in Europe.

This data reflects the fact that the European transport industry is a strong performer in R&D investment: in 2008 transport represented 31% of corporate R&D investment in EU while transport companies were responsible for 13.6% of EU corporate sales and 14.4% of EU corporate employees (DG RTD, 2009).

The conclusion from these figures is that, unlike the general situation, **lack of investment from the private sector does not seem to be a weakness of the European transport research and innovation system**.

However, an issue that can potentially show a weakness is the fact that corporate transport investment in R&D is concentrated amongst a small number of large companies. The Figure below displays the cumulative R&D investments realised by the 92 EU companies that are part of the 'transport' sector category.

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

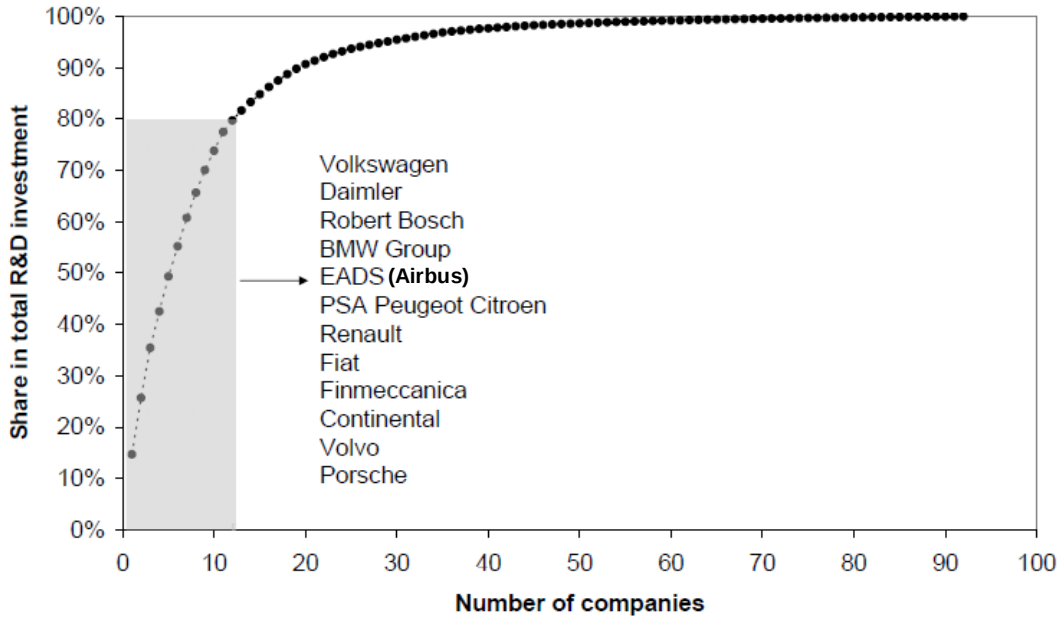

Figure 10: Cumulated corporate R&D expenditures from EU-based companies in transport R&D (2008)
Source: EU Scoreboard 2009 (DG RTD, 2009)

Only twelve EU companies accounted for 80% of the total of R&D investment related to the transport sector for the year 2008 and 28 companies will cover 95% of the total investment. 56% of the total R&D investment stemmed from German-based companies (e.g. Volkswagen, Daimler, Bosch, BMW, Continental), followed by French (19%) and Italian-based industries (10%).

This adds to the above mentioned concentration of European transport R&D funding in certain Member States (see Figure 5 to Figure 7). Indeed, even in the transport FP7 some countries participation is highly concentrated in some entities as can be seen in the next Table which identifies countries where the 5 national entities with more FP7 projects represent more than 60% of the total country participation.

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

Table 1: Participation in transport FP7 projects – Member States where the 5 top national entities play a more determinant role

	Nr of projects	Entity Share	% top 5
BULGARIA	**17**		
TECHNICAL UNIVERSITY OF SOFIA	3	18%	65%
HIGHER SCHOOL OF TRANSPORT - TODOR KABLESH	3	18%	
NATIONAL RAILWAY INFRASTRUCTURE COMPANY	2	12%	
APPLIED RESEARCH AND COMMUNICATIONS FUND	2	12%	
UNIVERSITY OF ROUSSE ANGEL KUNCHEV	1	6%	
CYPRUS	**9**		
EBOS TECHNOLOGIES LTD	2	22%	78%
FELDMAN ENTERPRISES LIMITED	2	22%	
RESEARCH PROMOTION FOUNDATION	1	11%	
GEOIMAGING LTD	1	11%	
SCHOLAI FREDERICKOU	1	11%	
ESTONIA	**7**		
TALLINNA TEHNIKAKORGKOOL	1	14%	71%
TALLINNA AUTOBUSSIKOONDISE AS	1	14%	
HAMA INVESTEERINGUD OU	1	14%	
LASER DIAGNOSTIC INSTRUMENTS AS	1	14%	
TALLINNA LINN	1	14%	
FINLAND	**50**		
TEKNOLOGIAN TUTKIMUSKESKUS VTT	18	36%	80%
VALTION TEKNILLINEN TUTKIMUSKESKUS	9	18%	
AALTO-KORKEAKOULUSAATIO	6	12%	
WARTSILA FINLAND OY	4	8%	
MOBISOFT OY	3	6%	
GERMANY	**320**		
DEUTSCHES ZENTRUM FUER LUFT - UND RAUMFAH	85	27%	64%
EADS DEUTSCHLAND GMBH	37	12%	
FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DI	36	11%	
RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSC	28	9%	
AIRBUS OPERATIONS GMBH	19	6%	
GREECE	**112**		
CENTRE FOR RESEARCH AND TECHNOLOGY HELLAS	25	22%	77%
NATIONAL TECHNICAL UNIVERSITY OF ATHENS	23	21%	
UNIVERSITY OF PATRAS	21	19%	
INASCO - INTEGRATED AEROSPACE SCIENCES CORP	12	11%	
HELLENIC AEROSPACE INDUSTRY SA	5	4%	
IRELAND	**27**		
UNIVERSITY COLLEGE DUBLIN, NATIONAL UNIVERSI	8	30%	74%
THE PROVOST FELLOWS & SCHOLARS OF THE COLL	4	15%	
UNIVERSITY OF LIMERICK	4	15%	
IRISH EXPORTERS ASSOCIATION	2	7%	
NAUTICAL ENTERPRISE CENTRE LTD	2	7%	
LATVIA	**5**		
RIGAS TEHNISKA UNIVERSITATE	2	40%	100%
MARITIME ADMINISTRATION OF LATVIA	1	20%	
VALSTS AKCIJU SABIEDRIBA LATVIJAS JURAS ADMIN	1	20%	
TRANSPORT AND TELECOMMUNICATION INSTITUT	1	20%	
LITHUANIA	**14**		
VILNIAUS GEDIMINO TECHNIKOS UNIVERSI	6	43%	79%
KLAIPEDOS UNIVERSITETAS	2	14%	
LITHUANIAN ROAD ADMINISTRATION UNDI	1	7%	
VIESOJI ISTAIGA SOCIALINES IR EKONOMIN	1	7%	
VIESOJI ISTAIGA KLAIPEDOS MOKSLO IRTEC	1	7%	
LUXEMBOURG	**6**		
DELPHI AUTOMOTIVE SYSTEMS LUXEMBOU	2	33%	100%
KATCON GLOBAL SA	1	17%	
GOODYEAR SA	1	17%	
SIMUDYNE SARL	1	17%	
CENTRE DE RECHERCHE PUBLIC HENRI TUDC	1	17%	
MALTA	**5**		
UNIVERSITA TA MALTA	3	60%	100%
HARBOUR AIR (MALTA) LIMITED	1	20%	
INTEGRATED RESOURCES MANAGEMENT (IF	1	20%	
NETHERLANDS	**179**		
STICHTING NATIONAAL LUCHT- EN RUIMTEV	49	27%	71%
NEDERLANDSE ORGANISATIE VOOR TOEGEP	33	18%	
TECHNISCHE UNIVERSITEIT DELFT	29	16%	
AD CUENTA BV	8	4%	
STICHTING MARITIEM RESEARCH INSTITUU	8	4%	
PORTUGAL	**66**		
INSTITUTO SUPERIOR TECNICO	14	21%	65%
TIS PT, CONSULTORES EM TRANSPORTES, IN	10	15%	
INSTITUTO DE SOLDADURA E QUALIDADE	10	15%	
INOVAMAIS - SERVICOS DE CONSULTADOR	5	8%	
GMVIS SKYSOFT SA	4	6%	
SLOVAKIA	**16**		
ZILINSKA UNIVERZITA V ZILINE	10	63%	100%
TECHNICAL UNIVERSITY KOSICE	2	13%	
ZTS VYSKUMNO-VYVOJOVY USTAV KOSICE A	2	13%	
LETISKO M. R. STEFANIKA - AIRPORT BRATIS	1	6%	
VYSKUMNY USTAV DOPRAVNY	1	6%	
SLOVENIA	**21**		
ZAVOD ZA GRADBENISTVO SLOVENIJE	6	29%	71%
UNIVERZA V LJUBLJANI	3	14%	
UNIVERZA V MARIBORU	3	14%	
INSTITUT JOZEF STEFAN	2	10%	
DDC SVETOVANJE INZENIRING, DRUZBA ZA	1	5%	
SWEDEN	**142**		
CHALMERS TEKNISKA HOEGSKOLA AB	28	20%	68%
KUNGLIGA TEKNISKA HOEGSKOLAN	21	15%	
TOTALFORSVARETS FORSKNINGSINSTITUT	20	14%	
VOLVO TECHNOLOGY AB	15	11%	
TRAFIKVERKET - TRV	13	9%	

Source: Market-up

Such concentration, which in some cases means that the top 5 companies are responsible for 100% of the participation in FP7 projects, can potentially mean that research potential is not fully exploited and /or national entities (in particular SMEs) may face difficulties in entering into the process. Indeed, in the Market-up review workshop, a brainstorming session was organised with several experts, the influence

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

of big companies on the innovation agenda was quoted as a barrier for increased SME participation in European research projects.

In this aspect, the transport industry differs from other industries because smaller companies are usually the most active in terms of innovation while bigger companies tend to remain in their comfort zone, buying smaller companies with innovative projects. Consortia are a way of reaching a compromise between the need for big institutions by aggregating smaller companies. However, even these are sometimes too much of a challenge for small companies.

In the case of transport, the volume of corporate investment in R&D does not appear to threaten research and innovation capabilities, but its concentration in a few large countries can prove to be a weakness.

Still it is worth noting that when analysing the involvement of SMEs in the FP7 the most important transport-related programme (i.e. TPT) is amongst those with higher SME participation, well above the 15% target established by the European Commission (see Figure below).

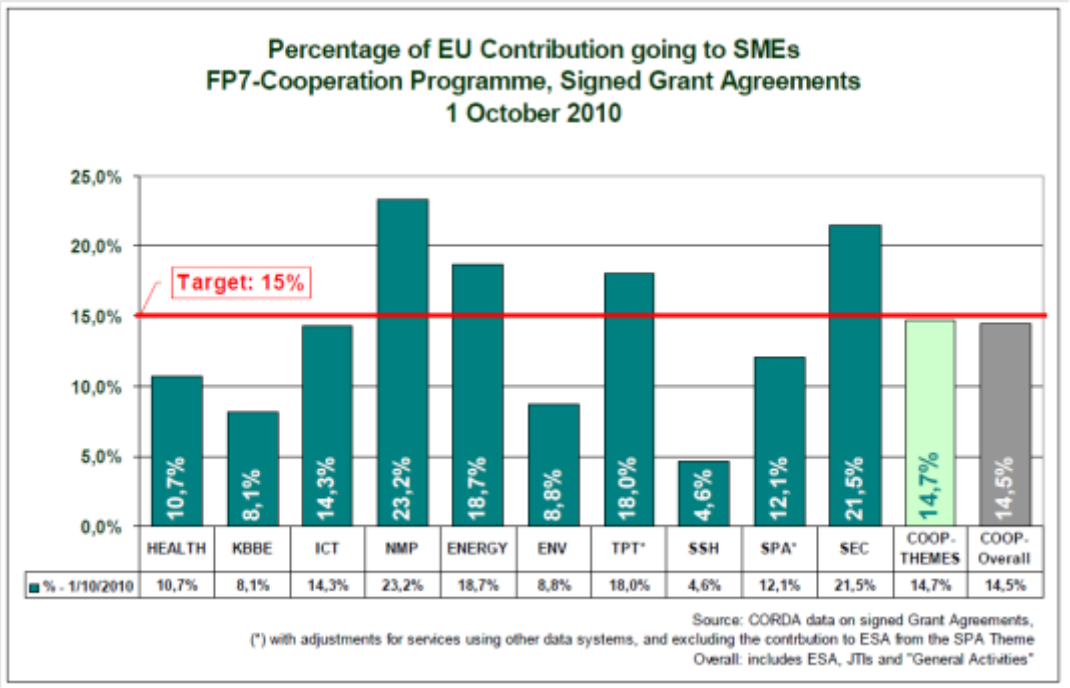

Figure 11: SME involvement in FP7
[Source: EC, 2010c]

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

Based on this information one may conclude that transport research and innovation remains concentrated amongst a relatively small group of large countries regardless of the achievement of the target for SME participation in FP7 programmes.

4.2. Insights from the mapping of competences of transport research in the EU-27

A substantial part of the Market-up resources devoted for Work Package 2 was invested in the mapping of competences for transport research in all European Member States for six modes of transport: rail, road, air and aeronautics, maritime, inland waterways and intermodal sector. This work was split between all partners of the Market-up project which were asked to perform focused desk research to identify key players and gather insights on the framework conditions for research in that Member State for that specific mode and gather information on local or regional funding sources.

From these efforts Market-up was able to prepare systematic information, but the challenge here is to subtract policy messages and conclusions from this work. In other words, by looking into the framework conditions for research separately in each Member State and in each mode are there any patterns or conclusions which are relevant for consideration at European level?

A first aspect that clearly emerges from this analysis regards the **difficulty that Market-up partners faced in identifying the key players on transport research and innovation on a given Member State**. The current information systems in place, such as the NCPs network[3] or the Transport Research Knowledge Centre (TRKC)[4], fail to allow a straightforward identification of key players and relevant competences across the EU. Most companies involved in EU research projects do have personal and corporate networks that facilitate identification of potential partners, but this absence of effective and independent information sources can make it potentially difficult for potential newcomers to get to know who is working in which field.

[3] http://www.transport-ncps.net/

[4] http://www.transport-research.info/web/, recently renamed into Transport Research & Innovation Portal

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

A second issue that was covered in this analysis regarded the capacity to identify national or regional funding sources and to evaluate the complementarities between the various funding schemes. For several Member States national or regional funding instruments were identified, however in some cases these funding lines did not cover all modes of transport. The Table 2 below summarizes the information on national funding instruments.

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

Table 2: Identification of national and regional funding instruments per mode of transport

Country	Rail	Road	Air	Maritime	IWW	Intermodal
Austria	✓	✓	✓		✓	✓
Belgium	✓	✓	✓	✓	✓	✓
Bulgaria						✓
Cyprus						
Czech Republic	✓	✓				✓
Denmark	✓			✓		✓
Estonia		✓				
Finland		✓		✓		
France	✓	✓	✓	✓	✓	✓
Germany	✓	✓	✓	✓	✓	✓
Greece	✓	✓	✓	✓		✓
Hungary	✓	✓			✓	✓
Ireland	✓			✓		
Italy	✓		✓		✓	
Latvia						
Lithuania	✓	✓	✓			✓
Luxembourg						
Malta						
Netherlands	✓	✓	✓	✓	✓	✓
Poland	✓		✓	✓		
Portugal		✓	✓			✓
Romania			✓	✓	✓	
Slovakia	✓	✓				✓
Slovenia	✓	✓		✓		✓
Spain		✓	✓	✓		
Sweden	✓	✓	✓			✓
United Kingdom	✓	✓	✓	✓		✓

The assessment of the consortium is that Table 2 clearly reflects the difficulties in obtaining information about national and regional funding instruments for transport research. Only in four Member States was possible to identify national funding instruments covering all six areas of research (Belgium, France, Germany and The Netherlands) while in 3 Member States no national funding instrument was identified.

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

It is hard to imagine that this information reflects the actual situation across Europe, being much more likely to reflect the fact that regardless of the desk review, performed by entities used to deal with transport research and innovation, and consultation with NCPs it was not possible to trace a good picture of financing instruments across the EU Member States.

In this activity Market-up partners doing the desk research were also asked to rank the role of each country in R&D in that specific mode. On the basis of such data, a questionnaire has been developed, which was sent to the FP7 supporting structure - National Contact Points for Transport (including Aeronautics) for validation of assembled data. In some cases a complete validation has not been obtained.

The analysis has been performed on the assembled data and a map of competencies has been developed. A simplified map, displaying the distribution of competencies based on the numbers of approved projects is shown in the next Figure.

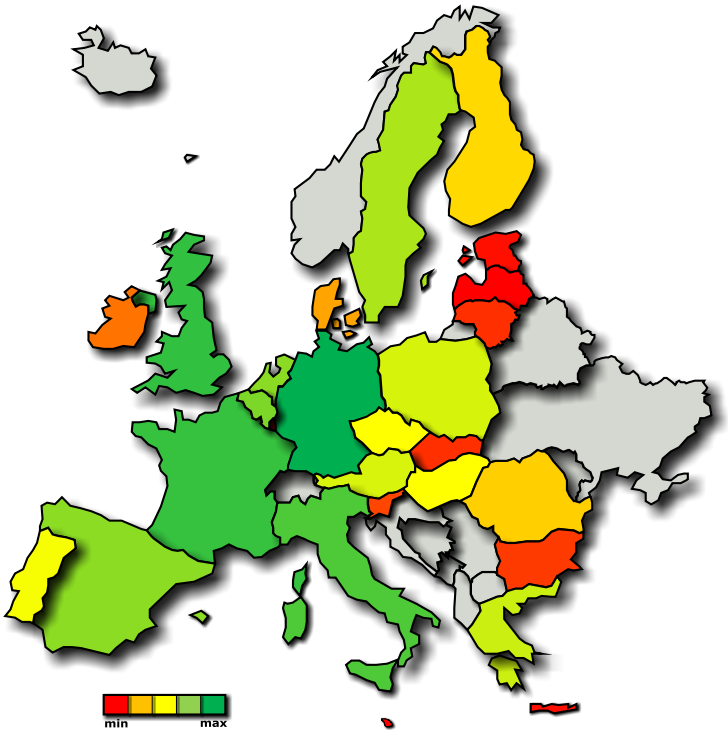

Figure 12: Distribution of competencies in transport research

Although the representativeness of this data may be questioned, the limitations of the desk research and validation process suggest it is the most efficient feasible way to assess competencies. Two interesting conclusions may be drawn:

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

- First, the fact the most important countries seem to be those with higher participation rates in transport FP7 projects (Germany, France, United Kingdom and Italy)
- Second, there are substantial similarities between Figure 12 and Figure 2, i.e. there appears to be a strong relationship with transport research capacities and a higher GDP shares of R&D expenditures; noticeable exceptions include, the United Kingdom, Italy, Poland and Greece seem to perform better on transport than in general, while Finland, Estonia, Czech Republic, Portugal and Slovenia seem to have a worst performance in transport research than their overall R&D expenditures would suggest.

Regarding the first conclusion, it is worth noting that it is quite possible that because information on FP7 participation is easier to access the people responsible for the desk research decided to rate higher those countries where more participants were identified. Still, it is important to note that there is consistency across this item, which probably results from the fact that FP7 has an active role in helping organisations to develop capabilities on transport research and innovation. The second conclusion is more important and is actually reinforced by the comparison of the results of the assessment of research capabilities for each mode and the presence of national research funding mechanisms. For road and air the countries that were rated with higher values in the research competences (i.e. more than 7, in a scale of 1-10) all have national funding mechanisms identified. For rail, maritime, intermodal and urban more than 85% of countries with higher rankings had a funding instrument identified, while for inland waterways this value was relatively low, as only two countries in six were ranked high in capabilities and had no national funding instrument identified.

From this analysis we can conclude that EU funding programmes, such as the FP7 play an important role in building up competences for transport research across Europe. However, it also seems clear that **the presence of national research funding programmes, complementary or additional to the European programmes, is key to achieve high levels of capacity on transport research and innovation**.

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

This conclusion is particularly relevant since in most cases Market-up failed to identify a national funding instrument for research on specific transport modes. This may not imply that such funding instruments do not exist, however, it shows the difficulties in identifying them. In most countries there is a lack of structured information on how to finance transport research and this appears to be an area where improvements are possible.

When information about national funding programmes is hard to obtain it becomes evident that access to corporate research funding programmes is even more difficult. This is a very sensitive issue in the transport sector, because of the high weight of transport research that is privately funded and given the concentration of these funding capabilities in a set of relatively low number of players. As a result the information obtained in the mapping of competences suggest that important barriers to entry in transport research and innovation programmes apply: first, getting to know the key players in each area is difficult and support is not widely available; second, national funding instruments seem to be available only in some Member States and information about them is also scarce; third, both European FP7 funding and corporate investment in R&D are highly concentrated in a relatively small group of players.

Furthermore, these obstacles in accessing to information on national funding instruments may affect negatively the identification of best practices implemented at national programmes which could have benchmark potential for implementing at EU level.

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

5. Research funding instruments

Research funding instruments play an important role in **shaping research activities**, including their priorities, **the phase of the innovation cycle that is addressed** but also in **encouraging the participation of weak players**. However, as the previous chapter shows they also play a prominent role in **creating research and innovation capacities in regions and countries**.

Being aware of the importance of research funding instruments for incentivising the market uptake of transport research, Market-up devoted its Work Package 4 to focus on this topic. The activities included an analysis of the available research instruments to facilitate market uptake of research results, looking into the issue of the involvement of SMEs, and the analysis of relevant measures for the market uptake of project results. Additionally, it also reviewed the potential role of the so-called *innovative economic and financial instruments*, which include relatively new mechanisms and incentives to the market take up of research results.

The specific results of this analysis were presented in Deliverable 4.1, however relevant policy messages also result from this work and will be discussed in this chapter. These are differentiated across three policy specific aspects:

- How the current funding landscape can provide support for entrepreneurs to bring "ideas to the market";
- The role of funding instruments to encourage the participation of weak players in research activities; and
- The orientation of the funding instruments to address the 'societal challenges' as defined in the Horizon 2020 Communication.

Before discussing such policy messages it is worth summarizing the approach of market-up in the analysis of funding instruments.

In Work Package 3 an assessment of seven case studies representing innovative clusters in the transport sector was undertaken, based on the application of the Technological Innovation System methodology derived from Bergek et al. (2008).

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

This methodology to analyse innovation systems was based on the consideration of all activities that contribute to the development, diffusion, and use of innovations as system functions. It promoted an assessment of seven innovation functions that are performed by a sectoral system of innovation, enabling an overall understanding of how well an innovation system is performing in developing new technologies and bringing them to the market.

The assessment of funding instruments performed in Market-up was closely linked with this case study analysis, reviewing how each instrument addresses specific innovation functions and accordingly allowing an understanding of whether it is focusing on the functions more related with market uptake, aiming to address the "valley of death". In Work Package 4 a screening of available instruments for funding transport research was performed and then the *relevant* ones were selected for detailed analysis[5]. From a global universe of 175 mechanisms Market-up was able to analyse in detail 54 mechanisms which have been organised in a matrix form, aiming to give a more general visualization of the financing transport landscape by positioning the mechanisms in function of the stage of innovation cycle and the main actors the mechanisms are addressed to. The result is presented in Figure 13.

[5] This selection was based on the assessment whether the funding instrument targeted market uptake phases or whether it provided funding for SMEs.

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

Figure 13: Matrix of funding instruments

ACTORS	STIMULATING DEMAND			NETWORKING / SETTING-UP INFRASTRUCTURE			FINANCING INNOVATION				SUPPORT SERVICES		
	Regulatory environment	*Public Procurement*	*Promotion of technology adoption*	*Human Capital*	*Infrastructure*	*Links (Clustering/ Networking /Partnering)*	*RTD*	*Tech – Innovation Demo, Pilot)*	*Non-Tech Innovation (Mkt, Promotion, Services)*	*Market Implementation of Innovation*	*IPR*	*TT*	*Internationalization (of Innovation)*
Industrial System	FP7					*PSRA-*	QREN, CDTI	*TransEco*			FP7		
Research System				Or, CCE			CCEM, I2, *PSRA-*, Or Yarok				FP7		
Industrial & Research System	TransEco, SSTDI, BNSDI, STEER, 1007	A3plus, DFT	Marco Polo, NBTP, DFT, SSTDI	TAKE, ERSR, DMOTN	Marco Polo, ILFC, 1007, DFT, *Transumo*, AMTRAN, BNSDI, A3plus, SCISM	*TransEc*, EUROGI	Swiss Electri, TAKE OFF, A3plus, MTT, ERSRC, CFF, CLEAN SKY, Swiss Energ, FRPA IV, Deufrako, MAROF, *SMARTRANS*, NAR, HRP, CHARME, *ILFTS*, *TransEco*, AMTRAN, CIP-IEE-		IVDTM, KOZ, HRP, SU, *Industria 2015*	Marco Polo, KOZ, A3plus, Swiss Energy, *ERSRC*, I2VSPlus, INTERREG IVC, IKV, Electromobility Technical Beacon	FCH, *Industria 2015*, Ways2Go, TAKE OFF		I2VS Plus	KOZ, QREN, CDTI, *SMARTRANS*
Political System	FP7	ETB	NBTP		*Transumo*, AMTRAN		Swiss Energy, PREDIT 4, SSTDI		PREDIT, BNSDI				
Innovation Infrastructure										CIP			

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

This matrix combines the different stages of the innovation process in one axis with the potential beneficiaries or actors of Research & Innovation support in the other axis. With this simple construction it is possible to address two dimensions considered as crucial in this process: *what for* (i.e. for what stages of the innovation process is the financial support intended?) and *to whom* (to which players is this financial support granted?). Transport modes and origin of the funding are also presented, according to the following colour scheme:

Transport Modes	Road	Rail	Maritime	Air	Intermodal	Urban	Cross Modal
Origin	Europe		National				

Based on these outcomes, as well as on the instruments detailed analysis performed in Work Package 4 it is possible to discuss policy relevant insights on whether the existing funding landscape provides a seamless financing system from basic research to the market (section 5.1), on its capability to finance the weakest players in the RDI system (section 5.2) and also on its focus in addressing society needs (section 5.3).

5.1. Funding market uptake of research results

This section revises the results of the analysis undertaken in Work Package 4 (and also Work Package 3) with the aim of assessing the extent to which the current transport research funding framework is achieving the objective of *providing seamless and coherent funding from idea to market*, which is part of the Horizon 2020 Communication. Moreover, it will discuss early indications on the need for Horizon 2020 to cover *activities from research to market with a new focus on innovation-related activities, such as piloting, demonstration, test-beds, and support for public procurement and market uptake* (EC, 2011a).

The matrix presented in Figure 13 provides interesting insights for this discussion, as it positions all relevant instruments along an axis according to the stages of the innovation process they address. The Table below provides an explanation of the stages of the innovation process presented.

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

Table 3: Stages in the innovation process (what for is support intended)

Context → Market

A. Stimulating demand for innovation: legal and regulatory measures to foster market demand for innovation	**Intervention at the level of Regulatory environment**: Measures to address the legal and regulatory framework (including adoption of standards) in order to facilitate innovation take-up.
	Public Procurement: Support to the adoption of clauses and regulation favouring the purchase of innovative products and services by the public sector
	Promotion of technology adoption: technology adoption (including e-government practices). Measures to stimulate or influence public behaviour and organisations towards a faster technology adoption (including e-government practices).
B. Creating the Innovation Ecosystem: measures to support innovators in the development of conditions favourable to innovation	**Human Capital**: Support related to investment in people, such as creation of employment, mobility and training
	Infrastructure: Support related to the acquisition of equipment, space, setting-up of laboratories or other structures needed for innovation development
	Links (Clustering/Networking/Partnering): Support related to initiatives encouraging interactions leading to transfer and sharing of knowledge and conditions for innovation, such as establishment or participation in partnerships, clusters, associations, or networking
	Information: Provision of, or support to accessing, information necessary for innovation development, such as roadmaps for public funding, partner searches, National Contacts Points (NCPs), pragmatic information, guidance, etc.
C. Financing Innovation: provision of financial support to the development of innovation	**Tech – Innovation (R&D)**: Financial support related to the development of technological innovation, such as research, proof of concept, development of prototypes and beta versions, including demonstration and first stage pilots
	Non-Tech Innovation (Design, Marketing): Financial support related to the development of non-technological innovation, such as design, research on new services, marketing processes or other.
	Market Implementation: Financial support for the initial market implementation of innovation, including large scale pilots or demonstrations involving end users, feasibility studies or market exploitation
D. Supporting Commercialization: support measures for the commercial take up of innovation in wider markets, beyond the first level of end users or market niches	**Intellectual Property Rights**: Support measures related to protection of Intellectual Property Rights for innovations
	Technology Transfer: Measures to support the transfer of innovation towards other organisations, markets of sectors facilitating its diffusion through ensuring that innovation results are wider accessible and may be further developed and exploited into new products, processes, applications, materials or services.
	Internationalization of Innovation: Support measures to facilitate the export of European innovation results into external markets

Looking back to Figure 13 it can be noted that the stages for which a higher number of instruments were identified are on the provision of financial support to the development of innovation (R&D activities) and the investment in financing the research infrastructure. At

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

the other end one can observe that financing instruments for supporting commercialization appear in a lower number, i.e. support to grant protection of Intellectual Property Rights for innovations, technology transfer or internationalization activities, as well as those focusing in stimulating demand for the innovations. Although this analysis does not take into account that some instruments are broader in budget and scope than others, **it provides an indication that it is easier to find research funding mechanisms for the phases of basic or applied R&D and demonstration than for the market pull phases of commercialization, market accumulation or diffusion**.

In addition to this matrix the financing instruments were also reviewed in Work Package 4 to determine whether they included specific provisions for push measures which may increase a project's success in bringing their innovations to the market. As a result of discussions within the consortium, the following list of measures has been identified as the main drivers for facilitating the entrance to the market of a project result:

A. Implementation of dissemination and communication plan (website...)

B. Business Plan and Financial Plan

C. Market research (Clients Segmentation/ partnering/internationalisation...)

D. Technology Transfer Assessment (Pricing/agreement (licensing, etc.)

E. End User - involvement

F. Pilot scale applications/Prototypes

G. IPR issues and foreground protection

H. Demonstration

I. Standardisation and certification

J. Identification of additional investment (financing sources, e.g. equity financing, CIP)

K. Support creation of new high-tech firms e.g. through incubators, support to academic spin offs, etc.

The Figure 14 shows the results of this analysis based on the review of 54 European and national financing mechanism for the Transport sector[6].

[6] The 54 funding instruments are included as annex to D41 and available for download from www.market-up.org

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

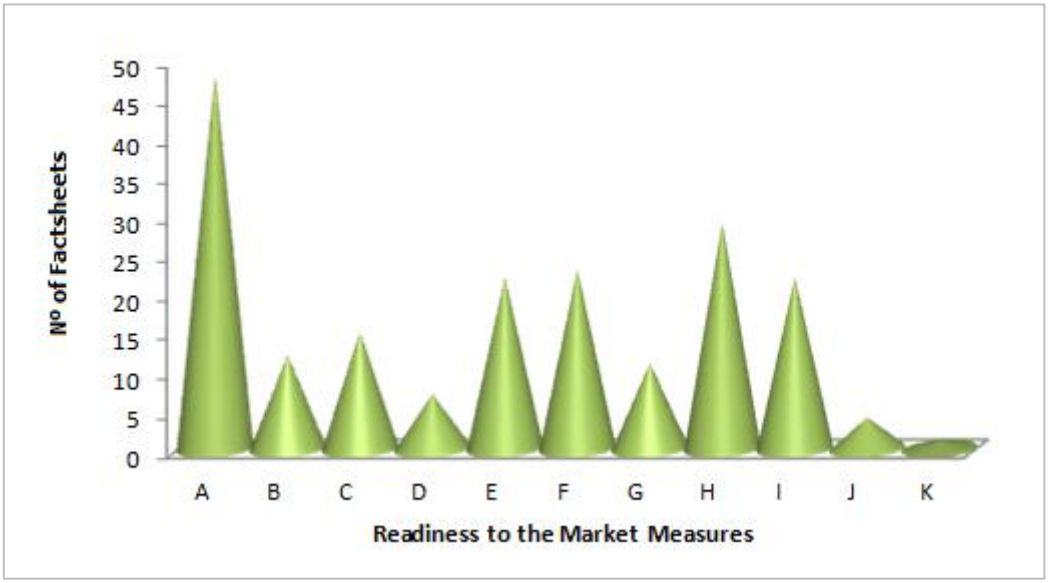

Figure 14: Readiness to the market measures present in selected funding instruments

The Figure shows that the implementation of dissemination and communication plan emerges as the most common market measure promoted by the funding instruments, by a wide margin, being present in the vast majority of the instruments reviewed. It is then followed by incentives to demonstration activities, which feature in more than half of the instruments. However, the remaining measures only feature in a minority of the instruments reviewed. In particular, there are very few funding mechanisms push for Technology Transfer Assessments, Identification of additional investment and Support creation of new high-tech firms.

It is important to consider the stage of development of a certain project result to efficiently define the type of support it needs for getting close to the market. In the case of pilot scale applications and prototypes, measures such as demonstration activities addressed to specific targets can contribute to raise interest; however frequently these type of results need additional funding once the project has ended. It is at this point where measures like professional support for business plan development, market research and business strategy definition can open the doors for investment opportunities: both private such as venture capital, business angel or corporate funding, and public in programmes like Competitiveness and Innovation Programme (CIP) or European Investment Bank (EIB).

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

This analysis signals that most of these funding mechanisms seem to be much more focused on promoting measures that increase the visibility of the project, e.g. dissemination and communication plan or end user involvement, rather than those which would focus in fostering the market take up of innovation, such as the preparation of a business plan or the identification of additional financing for follow-up activities. The picture one gets from this analysis is that **the funding schemes have little focus on financing closer-to-market activities or market analysis and development plans, which reflects the "valley of death" noted in the Innovation Union Communication** (EC, 2010a).

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

5.2. Encouraging the participation of weak players

For the European transport innovation system to work in an effective way it is important to ensure that it is open to the participation of all types of players, especially those that may play a prominent role in bringing innovation to the market. Some specific characteristics of the transport sector make this analysis particularly important. Unlike other areas of knowledge (e.g. computer systems) there are certain aspects of transport systems which make it more difficult for an outsider with an innovative idea to develop and bring it to the market. As an example of this, we will discuss two rather well known examples: (1) regulation and standardization, and (2) presence of externalities.

The transport sector is regulated by a wide diversity of bodies, which define a set of **rules and type approval mechanisms** that govern its most important sub-systems, such as infrastructure or vehicles. These detailed rules normally aim to safeguard the users, as for example to ensure safety and security, to ease seamless and interoperability in the systems, or for environmental protection purposes. We will not discuss whether these aims justify the means employed. The key point for this project is that they do impact the market uptake of innovative technologies, products or services as innovators need to demonstrate compliance with all these norms and standards before being launched in the market.

For example, while a couple of engineers with little resources can sit in a basement develop and launch in the world market a new software or computer application, the same does not appear to apply to someone that comes up with a new kind of engine for a plane or for a car. Before being able to launch it in the market, that engine would need to go through numerous safety and reliability tests and a full type approval procedure, for example to measure its pollutant emissions or its noise levels. Some of these approval procedures apply at different levels (e.g. United Nations Economic Commission for Europe, European Commission, Member States) and are not always mutually recognized across borders. In addition, to be successful in the market such an engine would need to fit with other car systems in a seamless way. So, instead of just a few engineers, transport innovation generally requires a working team of people from different areas, including not only the technology engineers, but also lawyers or safety experts for example.

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

Another key feature of the transport sector is the **presence of externalities**, which affect the market potential of certain innovations in the transport sector. According to economic theory, an externality is a cost or benefit that is not transmitted through prices and is incurred by a party who was not involved as either a buyer or seller of the goods or services causing the cost or benefit (Pigou, 1920). In the case of both negative and positive externalities, prices in a competitive market do not reflect the full costs or benefits of producing or consuming a product or service. Producers and consumers may neither bear all of the costs nor reap all of the benefits of the economic activity, and too much or too little of the goods will be produced or consumed in terms of overall costs and benefits to society. In transport numerous externalities occur, both negative and positive, and in both cases they affect research and innovation.

The noise effects of road transport are a common example of a negative externality. In their activity cars and trucks cause noise pollution, which impacts the health and quality of life of the people living or working near the roads they are using. This has an effective economic impact, e.g. it will affect property values or force people to retrofit their houses and windows to reduce indoor noise. However, the drivers of the cars that actually *cause* the problem are normally not asked to pay for the noise they generate and accordingly they don't have an incentive to drive less and/or to use vehicles and systems with lower noise emissions. This will then have an impact on research and innovation efforts because, for example, if someone develops a new type of tyre that reduces the noise levels it will certainly face a difficulty in the market uptake phase derived from the fact that those who buy the tyre – their potential clients – are not the ones who bear the costs of higher noise, not value properly the innovation within the product.

These two examples explain why in numerous cases research and innovation in transport is seen as *relatively* expensive, which may be amongst the key factors determining transport investment in R&D concentration amongst a small number of large companies. As a result of such aspects that make it more difficult for small companies to engage in transport research it becomes particularly important for the transport funding instruments to promote mechanisms to facilitate participation of weaker players, such as SMEs.

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

From the analysis of the matrix in Figure 13 it is clear that most instruments address the industrial and research system, which means that they pursue partnerships between market-oriented parties and more basic research organisations in the consortia composition. Moreover, in recent years, an increase has been visible on the promotion and encouragement of the necessity of bringing together the industry system (with special emphasis on SMEs participation) and the research community, not only at the research stage but for the "market" stage where aspects like readiness to market, commercialization and exploitation of project results, become of crucial importance. **This is certainly a positive trend that is expected to deliver positive results both in engaging weaker players in transport research but also in improving the market uptake of transport research results.**

When looking in particular to the issue of SME participation in funding programmes, there is a fairly balanced distribution of instruments that specifically require or encourage SMEs participation (42%) and those that do not require or do not specifically state the requirement of SMEs participation (58%). Some financing instruments even offer specific measures or initiatives addressed to SMEs. From the analysis conducted in Market-up Work Package 4, it has been found that about 26% of the instruments analysed presented specific measures or initiatives addressed to SMEs.

These numbers are encouraging and add to the above mentioned fact that within transport themes the participation of SMEs in FP7 already exceeds the target of 15% (see Figure 11). However, it should again be noted that transport research investment is highly concentrated in a few large players and only a minor share of EU innovative SMEs active in the Transport sector are involved in FP7 Transport projects, with numerous SMEs in the sector of transport services still not participating in those programmes (Technopolis, 2011). It can even be argued that most of SMEs that are innovative and that have R&D expenditures (intra or extramural) do not participate. If one assumes for instance that 5% of SMEs with more than 10 employees in this sector are innovative and have R&D activities, the EU sector of transport services is composed of something like 5,500 SMEs with more than 10 employees that are innovative. This figure is far larger than the 318 SMEs that have participated in the FP6 programme.

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

Table 4: Comparison of number of innovative SMEs in the sector of Transport and number of SMEs that participate in the FP7 or participated in the FP6 (in 2006)

	Number of companies
Estimated number of innovative SMEs in the sector of Transport	5.675
Number of SMEs involved in the FP6	318
Share of innovative SMEs of the Transport sector involved in the FP6 transport-related thematic/sub-thematic	5,6%
Number of SMEs involved in FP7 Transport programme	128
Share of large innovative companies of the Transport sector involved in FP7 Transport programme	2,2%

[Source: Technopolis, 2011]

It is difficult to unveil the reasons behind this observation. They might be related with the characteristics of the transport sector described above, which may suggest a less SME-friendly research environment. Moreover, unlike other sectors (e.g. ICT) there are many SMEs in the transport sector that perform day-to-day support activities which generally are not very prone to innovation (e.g. many truck drivers have their own "SME", mechanical workshops, etc).

However, these numbers may also be related with well-known barriers for SME participation in European research activities. For example, issues related to the development of innovative products and services, difficulties accessing to information, networking and partnering with relevant stakeholders, difficulties accessing to finance, and acquiring other types of services that could improve their competitiveness e.g. better qualified staff.

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

Regardless of this observation, Market-up analysis indicates that there is a **strong effort at European and National level to overcome this situation by proposing measures that support SMEs aiming to increase their participation in funded programmes and creating specific measures for SMEs with the objective of improving their competitiveness**. Accordingly, this seems to be an area where additional research is needed as there seems to be a disconnection between the mechanisms existent in research instruments for incentivizing SMEs participation and the observed share of transport SMEs engaged in R&D. Amongst other questions, such research should look into whether this is related with the specifics of the transport sector (identified above) with the type of SMEs active in transport or with the barriers related with the organisation of R&D funding.

This is very important as there *seems* to be an untapped reservoir of innovative transport SMEs to participate in research activities, and there are numerous studies, such as the Eurogia+ programme, noting the importance of the right combination of large enterprises, SMEs and research institutes, as each type of actor brings valuable features to the projects. The analysis performed in Work Package 3 reinforces this assessment, as the case studies results show an interesting dichotomy of a few large companies dominating a large part of the total patenting activity in a given technology, but at the same time, the role of small specialised companies becomes obvious. The role of specialised companies is more pronounced for biofuels and fuel cells than for electric vehicles.

5.3. Orientation of the funding instruments towards addressing 'societal challenges'

As mentioned above, the Horizon 2020 Communication (EC, 2011a), which presents the plans for the European Commission main research and innovation funding programme outlines as a priority to focus research investment in addressing the *societal challenges*, i.e. the policy priorities of the Europe 2020 strategy, and addresses major concerns shared by citizens in Europe and elsewhere. Six societal challenges are listed, with transport being the main area of one of them and having close links with all others:

- Health, demographic change and wellbeing;

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

- Food security, sustainable agriculture, marine and maritime research and the bio-economy;
- Secure, clean and efficient energy;
- Smart, green and integrated transport;
- Climate action, resource efficiency and raw materials;
- Inclusive, innovative and secure societies.

Against this background, and considering that this approach proposed by the Commission is still being discussed by the European Parliament and Council, it is worth analysing how the current European research funding instrument – the FP7 – is actually succeeding in promoting a focus of RDI in addressing these challenges.

The first useful indicator regards the distribution of transport FP7 funding between the various modes of transport. The European Commission Joint Research Centre has published a report in 2011 where an estimation of the annualised EC funding under FP7 by mode of transport is presented. These results are shown in the Figure below.

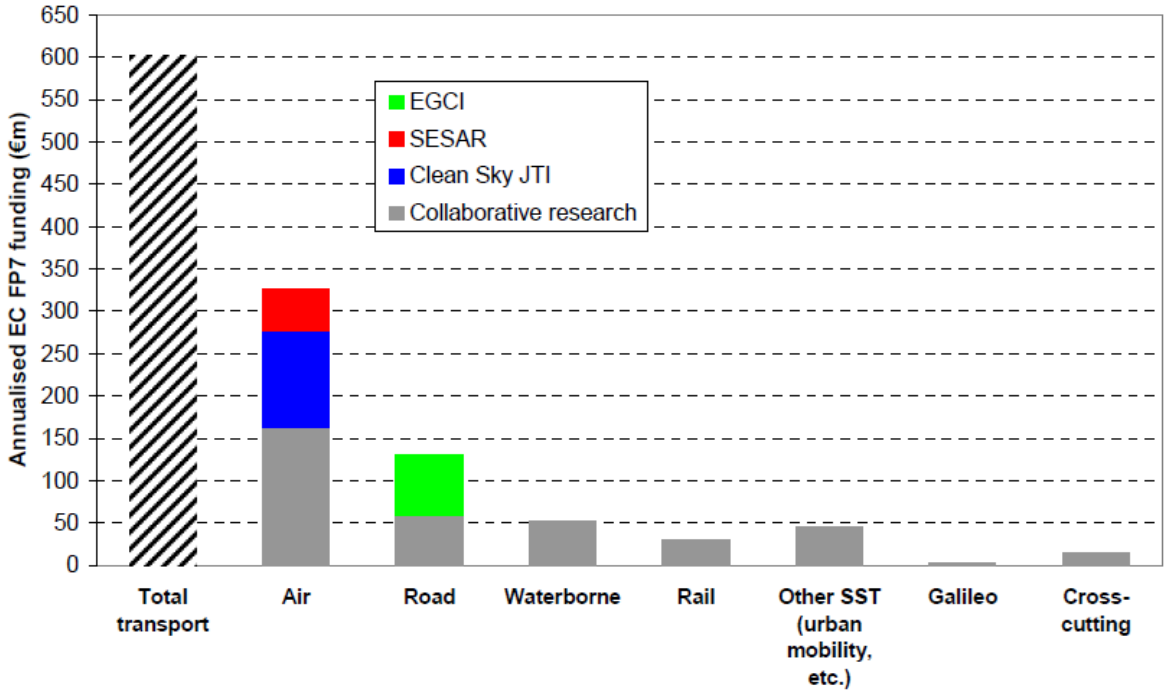

Figure 15: Repartition of the EC FP7 funds (annualised)

[Source: Wiesenthal T., *et al*, 2011]

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

Transport research projects under FP7 cover all modes of transport (people and goods) and reflect the objectives and research priorities defined by the strategic research agendas of relevant technology platforms (e.g. ERTRAC for road, ERRAC for rail, WATERBORNE TP for waterborne transport and ACARE for air transport; as well as the contribution of EIRAC for intermodal). While this approach is seen as effective in engaging industry in developing priorities for the European public R&D investment it should be discussed whether it is also delivering in terms of making such priorities address societal challenges.

The first element that emerges from the analysis of Figure 15 is that air transport is, by a large margin, the mode of transport with higher amounts of European public investment in R&D. Indeed more than half of the total investment (54%) is dedicated to aeronautics research and 22% to road research. Waterborne and rail research account for only 9% and 5% of the total EC funding towards transport respectively, which may already include some cross-modal research. Finally, around 10% of the EC funding is directed to research activities non-specifically related to one transport mode e.g. urban mobility, transport policies, Galileo, cross-cutting research. The above figures include collaborative research projects as well as the Clean Sky JTI, SESAR JU and the European Green Car Initiative. If only collaborative research projects had been analysed, the dominance of aviation and road research would be less pronounced (Wiesenthal T., et al, 2011).

Looking back into the societal challenges one might conclude that the main objective of this investment in transport research should be tailored towards promoting "smart, green and integrated transport". Indeed, as shown in Table 5, both in the Aeronautics and air transport and in the sustainable surface transport (rail, road and waterborne) programmes research priorities include elements related with "green and smart transport".

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

Table 5: Research priorities of the different transport modes under FP7

Aeronautics and air transport
Reduction of emissions, work on engines and alternative fuels
Air traffic management, safety aspects of air transport
Environmentally efficient aviation
Sustainable surface transport (rail, road and waterborne)
Development of clean and efficient engines and power trains
Reducing the impact of transport on climate change
Inter-modal regional and national transport
Clean and safe vehicles
Infrastructure construction and maintenance, integrative architectures

[Source: Wiesenthal T., *et al*, 2011]

However, one thing that immediately emerges from Figure 15 is the relatively low investment in cross-cutting issues. Although some modal issues may be addressed in the modal categories, achieving "integrated transport" is clearly signalled as a major societal challenge but not reflected in the budget allocation for cross-modal and cross-cutting issues.

Having in mind that European research and development investment represents only a minor share of total RDI investment in the EU, it is worth discussing whether it has a leadership role in framing R&D activities in national or corporate programmes.

The Figure below shows the distribution of public R&D funding across the different modes of transport, outlining the share of which refers to the European funding.

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

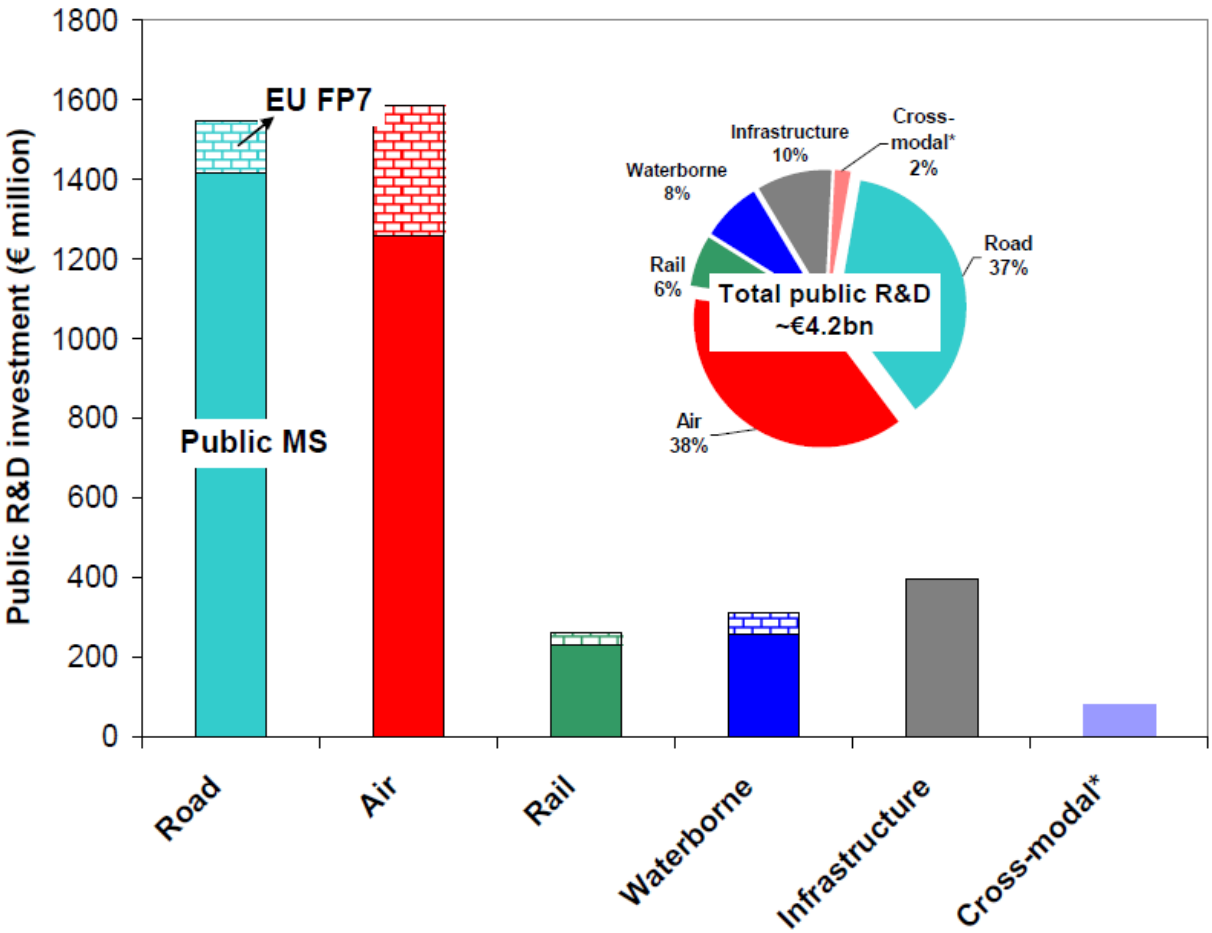

Figure 16: Estimate of public R&D investments (annualised)

[Source: Wiesenthal T., *et al*, 2011]

It is clear that Member States are devoting more resources to road transport than to aviation. However, it can be seen that investment in cross-modal issues also accounts for a very small fraction of total public funding for R&D in the EU. The Figure 17 below adds to this the information about private research investment, being possible to see that when corporate funding is added to the equation road clearly emerges as the mode of transport with higher R&D investment.

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

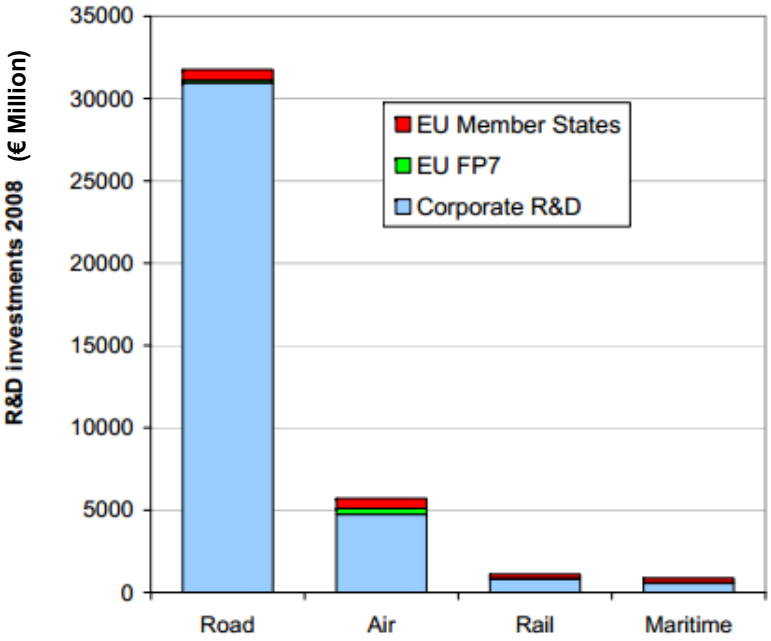

Figure 17: Total R&D investments of EU-based companies and public funds by transport mode [Source: Wiesenthal T., *et al*, 2011]

This analysis shows that, in general, European R&D investment has little impact in influencing the focus of R&D investment. The high share of funding attributed to aviation at EU level is not fully reflected in the investment by Member States and companies. The issue of the lack of funding for cross-modal issues seems to be much more significant.

In summary **the analysis performed showed that the investment in FP7 does not appear to be addressing societal challenges in a balanced way**. Amongst some questions on the distribution between modes of transport, there appears to be a certain lack of resources devoted to cross-cutting issues and intermodal transport, which appear to be key in achieving the societal challenge more directly related with transport.

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

6. Policy recommendations

The analysis undertaken in Market-up provides important insights into the functioning of the European transport research and innovation system. It focused mostly on the aspects related with the market uptake of transport research results and on the engagement of weaker players particularly SMEs, while developing a unique overview of the system in terms of the mapping of competences and overview of financial instruments. The conclusions from this work were discussed in the previous section and the objective of this final section is to outline specific policy recommendations that resulted from the work of Market-up.

Most of the aspects discussed in this document do have policy implications and merit attention by policy makers. However, the objective of WP5 is very well defined - *to formulate specific policy recommendations on potential for uptake of innovation in transport sector, focusing in particular on transport results and technologies and involvement of actors (encouraging weak players)* - and accordingly the policy recommendations will focus on the two aspects identified: recommendations for improving the market take up of research results and recommendations to encourage the involvement of weak players.

6.1. Improving the market take up of research results

There are several aspects discussed in the previous chapters which present relevant insights regarding the issue of the market uptake of transport research results.

The first regards the actual **investment in R&D**. Lack of private investment in research and development activities are often seen as a major barrier weakness of the European research and innovation system. However, the analysis performed in Market-up actually reveals that in the specific case of transport private investment by European companies is much higher than average and European based players have a leadership role in R&D investment at worldwide level. We have to assume that this investment is strongly oriented towards market applications, as companies would only seek technological

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

breakthroughs or innovative solutions if these would allow them to take an economic benefit or achieve a competitive advantage in the future.

If we relate this observation with the fact that **transport is a sector where standards and regulations are highly detailed** but that at the same time **there is a need to better focus research and innovation efforts in addressing societal challenges**, one may conclude that policy makers can boost R&D and ensure it targets societal challenges by adopting regulation which rewards companies that invest in innovation. Indeed, if European Regulation is designed in a way that gives companies that come up with innovative solutions a competitive advantage that it is very likely that it would have two beneficial effects: it would create further incentives for RDI investment and it would ensure a focus of such investment in addressing societal challenges.

A concrete example of how to implement such policy making process can be obtained by analysing emission regulations on passenger cars. The emissions of air pollutants, such as nitrogen oxides (NOx), total hydrocarbon (THC), non-methane hydrocarbons (NMHC) or carbon monoxide (CO) are regulated by the definition of "Emission Standards" which establish limit values that all new cars need to comply in order to access the European market[7]. When a new "Euro Class" is announced to enter into force in a couple of years all car makers have a very strong incentive to develop the necessary solutions to meet the new standards, otherwise they take the risk to be ruled out of the market: the "Euro 6" standard is scheduled to enter into force in January 2014 reducing the emissions of NOx from diesel cars, from 180mg/km to 80mg/km, and all cars emitting more than this will not be allowed. Accordingly car makers will need to develop a compliant vehicle, however the incentive to reduce emissions will stop at the limit value and there will be no benefit from developing a car with, e.g. 50mg/km.

This contrasts with the European Regulation of GHG emissions from passenger cars, where the legislator instead of defining a limit value opted for an *average* emissions level. According to the Regulation, manufacturers are obliged to ensure that their new car fleet does not emit more than an average of 130 grams of CO2 per kilometre (g CO2/Km) by

[7] These are commonly known as the "Euro Classes"; more information can be obtained in the website of the environment directorate of the European Commission: http://ec.europa.eu/environment/air/transport/road.htm

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

2015 and 95g by 2020[8]. Because it is an average level and because a longer term indicative target is defined from the onset there is a clear incentive for the industry to keep their RDI efforts even after achieving the target: they will get a market advantage from having a lower than average vehicles by allowing them to still commercialize better than average vehicles (there are also financial instruments in which such company can benefit) and the indicative target gives an important indication that RDI efforts in this area should be maintained as they will be rewarded in the future.

In conclusion the European transport industry already has a leading position in terms of R&D investment. **In order to improve the market uptake of research results policy makers are recommended to ensure that all Regulation and Standards adopted or reviewed are detailed in a way that rewards innovative solutions, notably by adopting provisions with technology neutrality, that promotes overachievement of targets and establishes indicative objectives for the medium and longer terms.**

Another important aspect identified in Market-up regards the existence of a "valley of death", a phase in the innovation cycle where funding instruments fail to provide adequate support. This is reflected by both a certain concentration of funding in earlier phases of the innovation cycle (e.g. knowledge production) and a certain absence of focus on financing closer-to-market activities, market analysis and development plans. In order to address this issue **policy makers are invited to increase the amount of closer to market activities in financing instruments**. In the case of the European research and development financing programme, the European Commission has proposed that the new programme, i.e. the Horizon 2020, should address this issue, which is a welcome move that should be backed by both the European Parliament and Council. The European Commission is also recommended to increase its capacity to support financed projects in completing their innovation cycles. This implies increased provisions to ask projects to include aspects such as market research or preparation of business plans, but also to ensure that guidance material is available and that proposal evaluators take these aspects into account.

[8] more information can be obtained in the website of the climate directorate of the European Commission: http://ec.europa.eu/clima/policies/transport/vehicles/index_en.htm

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

For example, the focus of FP7 projects on dissemination seems to be a potential success story. The fact the Commission pushes for appropriate dissemination of project activities results both in the call for proposals, in the evaluation and negotiation process and in its project monitoring has certainly contributed to the fact that the expert group performing the interim evaluation of the FP7 "is encouraged by the attention given to dissemination" (EC, 2010b).

Although dissemination seems to be well implemented and acknowledged by all participants as an important measure for creating visibility and closeness to the market, exploitation and sustainability plans on the other hand do not seem to have the same level of success. As for the case of dissemination, the EC also encourages the definition of sound and viable exploitation and sustainable plans for the projects, however, these usually encounter difficulties for implementation because of the lack of funding after the finalisation of the project.

It should also be clear that funding closer-to-market applications may imply funding projects which are increasingly riskier (i.e. projects that may actually fail). When approaching market stages of the innovation cycle one should assume that the projects with higher potential will easily get corporate or private funding, as potential market results incentivise companies to invest in those projects. However, there are projects which may be promising but which have high risks and fail to get private funding. Policy makers should discuss whether EU money should be invested in targeting such projects, having in mind that such financing is likely to result in many "failures". In order to be able to assess this, the European Commission may need to improve its capacity to deal with aspects such as marketing of innovation and business plans. One criterion to chose such projects is to focus on those that contribute to the achievement of longer term targets established in the Horizon 2020 programme.

Accordingly, policy makers are invited to consider **increasing the capacity of the European Commission services to work on supporting projects to include readiness to the market measures in their activities**. Guidance material should be prepared and a proficient application of such measures and activities should be clearly assessed in the proposal evaluation procedures. **In order to minimise the "valley of death" successful projects should be granted easier access to follow-up**

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

projects and/or specific funding lines to bring their results (closer to) the market. This should be done in a way that does not hamper the current competitive system for obtaining EU funding (e.g. assessment of "project success" and "market potential" by independent experts).

6.2. Encouraging weak players

From the analysis of market-up it clearly emerges that one of the weaknesses of the European transport research and innovation system is the concentration of competences. This concentration is occurring at two levels:

- Across Member States, where strong divergences in terms of transport research competences were observed;
- Within private research organisations, as research investment is concentrated in a small group of (large) companies and also a small number of companies dominate participation in FP7 projects, especially in some Member States.

This suggests there is a need to act at two levels: first there is a need to increase opportunities for certain Member States to improve their capacities on transport research; second, the European funding programmes need to be more open to a higher number of participants.

For the first aspect, it seems crucial that **Member States implement national or regional funding mechanisms**, complementary to European funding, as this seems to be an aspect that strongly influences the observed pattern in terms of research capabilities for transport research across Europe. The European Commission should also maintain the incentives for involvement of partners from different countries in their funding for collaborative projects, but also foster Member State's investment in complementary funding, notably through other financial instruments (e.g. cohesion funds).

Regarding the second aspect, it was detected in Market-up that the existing information networks – such as the NCPs or the TRKC – seem to fail to provide an efficient platform to identify key players and competences on transport research. This aspect is particularly penalising for newcomers who, in the absence of informal networks, may need to rely on these for identifying and contacting potential research partners to build consortiums. This

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

is particularly relevant for SMEs, that being smaller and more specialized companies are less likely to have established networks of contacts and financial capacity to overcome this barrier. Accordingly there seems to be a continuing need to **support in all EU Member States (on a national level) participation of new players in European research projects**, with the improved use of recent FP supporting structures (NCPs) **and other relevant information providing networks** on the European and national levels. The European Commission should continue to fund activities that allow NCPs to work together and exchange best practices and information. In addition the European Commission should consider targeted funding for building capacity for NCPs working in countries with lower participation in research programmes or NCPs activities targeting weaker players (e.g. SMEs). Finally, establishing a network of regional contact points complementary to national contact points seems relevant and the European Commission should consider funding activities in this area.

In addition to the lack of support from established independent experts that can provide useful information on partners, funding schemes and opportunities, many SMEs and other weaker players have difficulties to engage with networks which are important to prepare successful proposals (e.g. public-private partnerships or the technological platforms). **Possibilities for all players to engage with these networks and have full access to relevant information on the European transport R&D funding should be increased, and specific funding lines to create resources for increased SMEs and their representing bodies participation in such networks should be created.**

It is worth noting that the FP7 includes a target for SME participation which, together with calls with SME oriented tasks, seems to be an effective instrument to ensure high levels of engagement of SMEs in the programme. Assuming such an instrument is maintained the focus should then be on measures that enlarge the number of total SMEs involved.

It is also worth noting that an up-to-date assessment such as the one prepared in the framework of Market-up could be a useful tool for supporting the work of NCPs and RCPs. Accordingly **the European Commission should consider developing a methodology to map competences on transport research and innovation at national and regional level and prepare a tool to ensure that such mapping is frequently updated – either centrally at European level or based on input by**

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

NCPs and RCPs. This can be implemented through the implementation in European regions of the Self Assessment tool provided in Europe 2020 Flagship Initiative Innovation Union (EC, 2010a) to regional transport research and innovation systems. It is important that such tool also covers **information on funding instruments** and devotes appropriate attention to the **engagement of weaker players**, such as SMEs.

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

7. References

- Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S., and Rickne, A. (2008) Analyzing the functional dynamics of technological innovation systems: A scheme of analysis. Research Policy 37[3], 407-429.
- Council of Ministers, 2011. Conclusions on Innovation Union for Europe. 3049th COMPETITIVENESS (Internal Market, Industry, Research and Space) Council meeting. November 2010. Brussels.
- DG RTD (2009): The 2009 EU Industrial R&D Investment Scoreboard, European
- Commission, JRC/DG RTD. http://iri.jrc.ec.europa.eu/research/scoreboard_2009.htm
- EC, 2010. European Commission Communication, EUROPE 2020: A strategy for smart, sustainable and inclusive growth. COM(2010) 2020 final. Brussels.
- EC, 2010a. European Commission Communication, Europe 2020 Flagship Initiative Innovation Union. COM(2010) 546 final. Brussels.
- EC, 2010b. Interim Evaluation of the Seventh Framework Programme, Report of the Expert Group. November 2010. Brussels.
- EC, 2010c. SME participation in FP7, Report, Autumn 2010. Brussels.
- EC, 2011. European Commission Communication, WHITE PAPER, Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system. COM(2011) 144 final. Brussels.
- EC, 2011a. European Commission Communication, Horizon 2020 - The Framework Programme for Research and Innovation. COM(2011) 808 final. Brussels.
- EC, 2011b. European Commission Public Consultation Report, Strategic Transport Technology Plan. July 2011. Brussels.
- EC, 2011c. Innovation Union Competitiveness report, 2011 edition. Brussels.
- EC, 2011d. EU Transport in figures. Retrieved December 2011, from Statistical pocketbook 2011:
- http://ec.europa.eu/transport/publications/statistics/doc/2011/pocketbook2011.pdf
- EP, 2011. European Parliament resolution, Innovation Union: transforming Europe for a post-crisis world. May 2011.

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)

- Eurostat, 2011. Statistics database. Online consultation. http://epp.eurostat.ec.europa.eu
- Leduc, G., Köhler, J., Wiesenthal, T., Tercero, L., Schade, W., Schade, B. (2010): Transport R&D Capacities in the EU. Deliverable report of GHG-TransPoRD (Reducing greenhouse-gas emissions of transport beyond 2020: linking R&D, transport policies and reduction targets). Project co-funded by European Commission 7th RTD Programme. Fraunhofer-ISI, Karlsruhe, Germany.
- Pigou, 1920. The Economics of Welfare. 4th Edition. Macmillan and Co., London, 1932.
- Technopolis, 2011. Interim evaluation of EU FP7 transport research notably within Theme 7 of the cooperation programme "Transport (including aeronautics)". Final report – Deliverable D7. Executive summary – deliverable D4. Technopolis Group. http://ec.europa.eu/research/evaluations/pdf/archive/fp7-evidence-base/evaluation_studies_and_reports/interim_evaluation_of_eu_fp7_transport_research.pdf
- T. Wiesenthal, G. Leduc, P. Cazzola, W. Schade, J. Köhler, 2011. Mapping innovation in the European transport sector. European Commission, Joint Research Centre, Institute for Prospective Technological Studies. Seville.

This project has been funded with support from the European Commission under Seventh Framework Programme (FP7)