



Turning Research Results into Successful Innovation

Insights from the FOSTER-ROAD Innovation Survey

Project Deliverable D.1.3 Innovation Aspects
Project acronym FOSTER-ROAD
Project full title Future of Surface Road Transport European Research
Contract No. EC FP7-Transport 605339

Date Issued 15 December 2016
Report RD16-003074-2

Report by Jane Patterson, Ricardo UK
Alexander Hollies, AVL
David Storer, CRF

Approved


Penny Atkins, Ricardo UK



The FOSTER-ROAD project has investigated success factors for and barriers to innovation in European road transport

Introduction

- Road transport Research & Technology Development (RTD) projects, co-funded by the European Commission or national programmes, often focus on delivering new or improved technologies and processes. Following the RTD project, these technologies and processes usually require further development for successful product innovation and commercial exploitation
 - For the purpose of this study, innovation is defined as *the application or deployment of a new or improved technology, product, design or service into the market*. Innovation is the successful commercialisation of an idea or invention
- The **FOSTER-ROAD project** has been investigating the challenges of turning research results into successful innovation. The project launched the “**Innovation Survey**” in May 2016 to collect opinion and insight into the potential success factors and barriers on the pathway from research to innovation and commercial exploitation
- In addition to considering innovation within road transport in general, the questionnaire is focused on the following specific application areas:
 - Market take-up of **battery-electric and plug-in hybrid vehicles**
 - From **connected vehicles to autonomous driving** in the urban and suburban contexts
 - Application of **composite materials** for weight reduction in mass-produced vehicles
- The results from the Innovation Survey are presented in this report



An online Innovation Survey was used to collect opinion and insight regarding RTD commercialisation

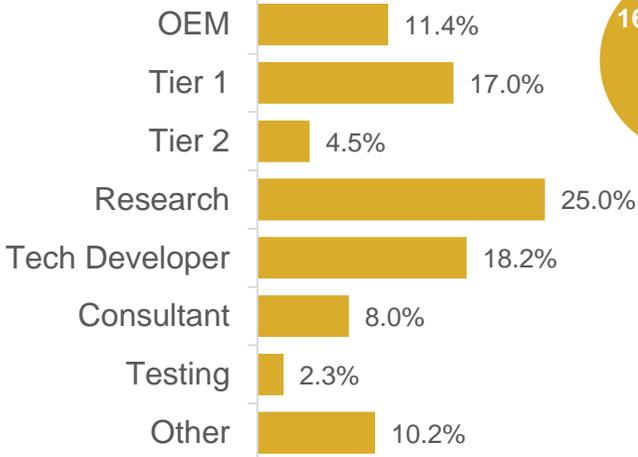
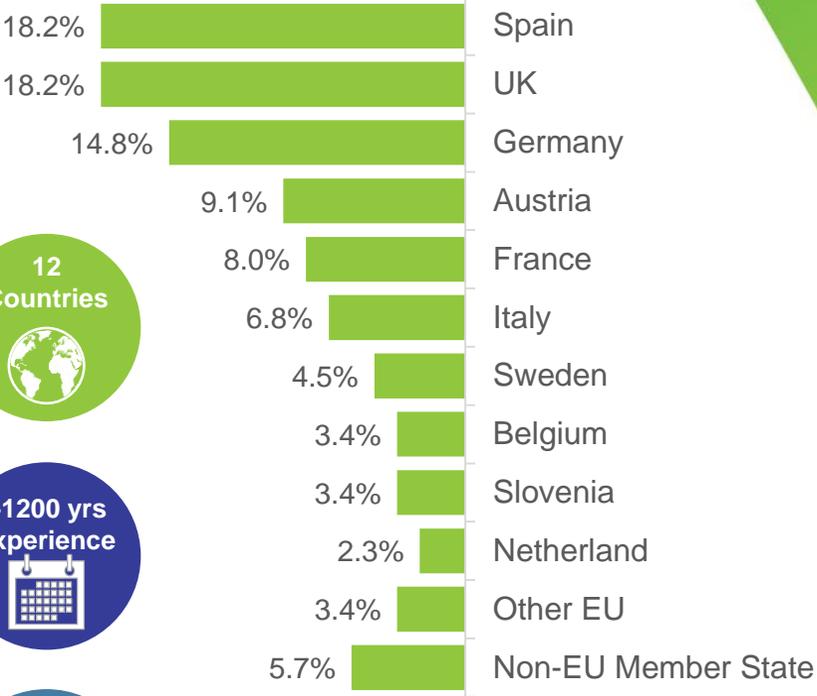
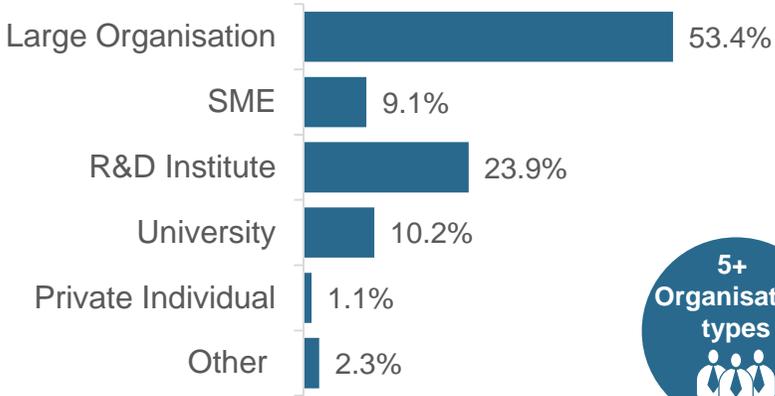
The Innovation Survey

- The FOSTER-ROAD online Innovation Survey was conducted between April and June 2016
- FOSTER-ROAD project partners were encouraged to complete the survey, along with other stakeholders within the automotive and transport RTD community
- Participants were invited to contribute their opinions on:
 - Internal Success Factors and Potential Barriers to Innovation
 - The Role of Government in supporting Innovation
 - Other External Factors
 - Specific experience from EV & PHEV, Connected Vehicle and Composite Material projects



88 experts and stakeholders participated in the Innovation Survey, from across the EU and beyond

Innovation Survey Participants



The majority of participants had >10 years' experience. Typical roles included senior and middle management, researcher and programme management



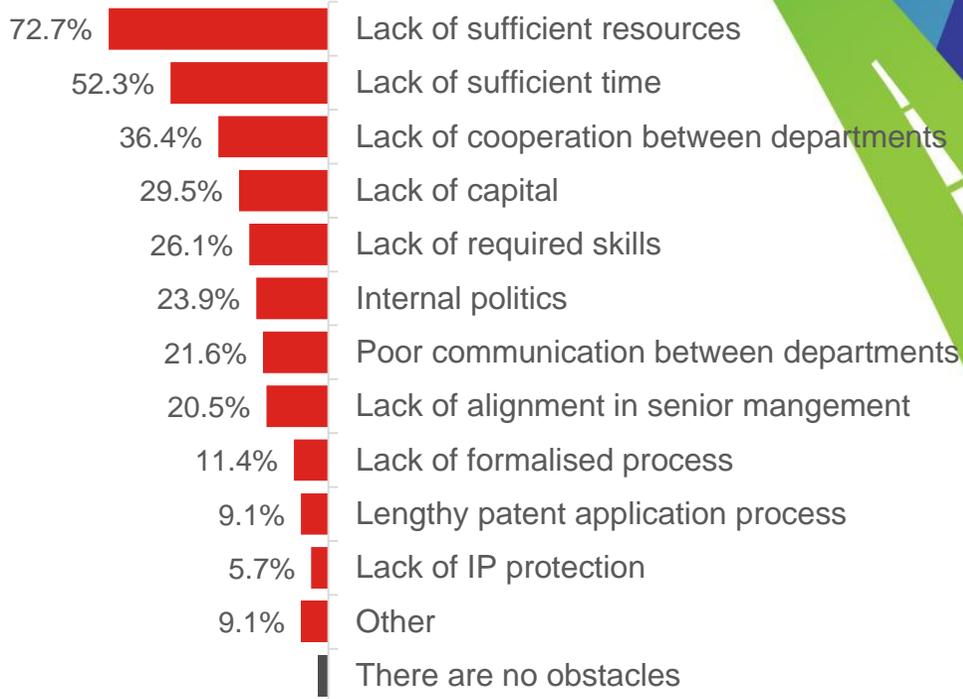
Results indicate that organisations are keen to encourage innovation, but lack of time & resources are obstacles

Survey Results – Internal Factors & Barriers

How organisations encourage innovation



Innovation obstacles within an organisation



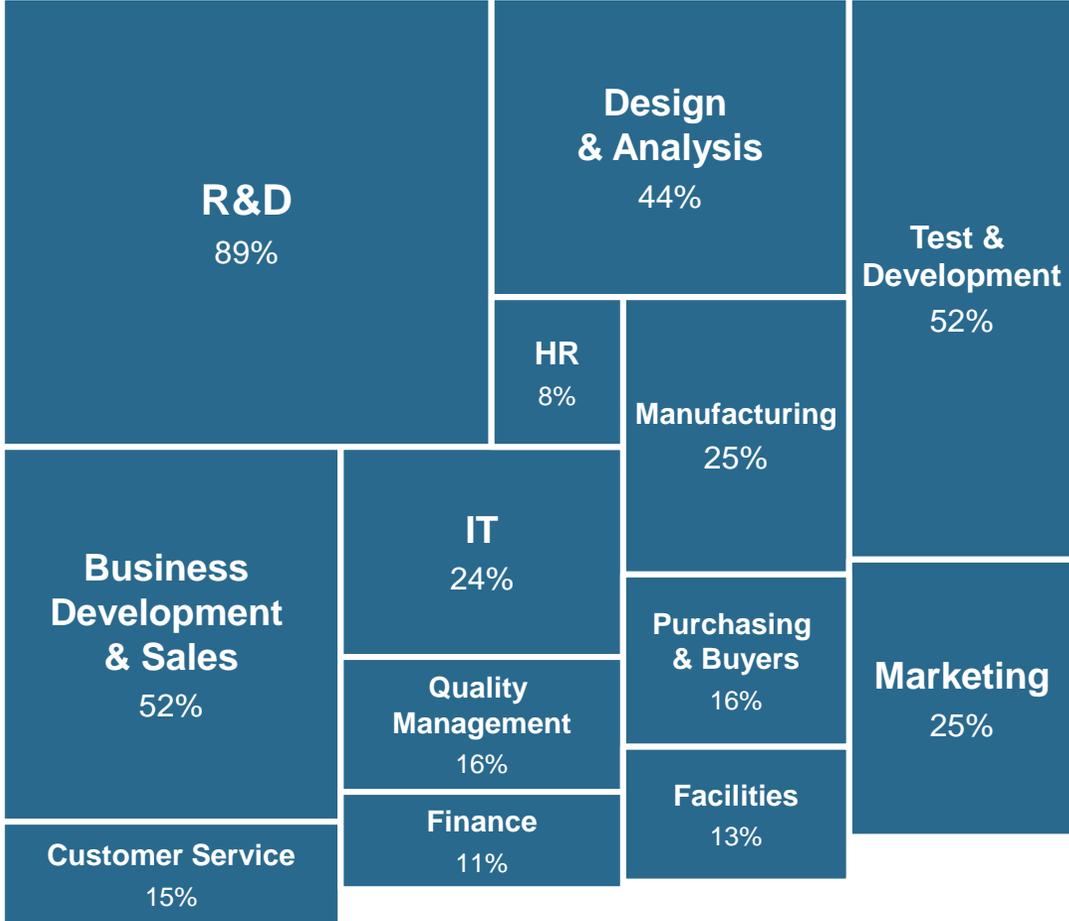
Most participants thought their organisations have a continuous flow of good ideas coming through (84%), and set effective priorities for innovation (76%). Developing alliances with external partners, hiring creative people, and setting aside time were popular mechanisms for encouraging innovation. Whereas, insufficient resources and time, and lack of cooperation were seen as strong obstacles to innovation.



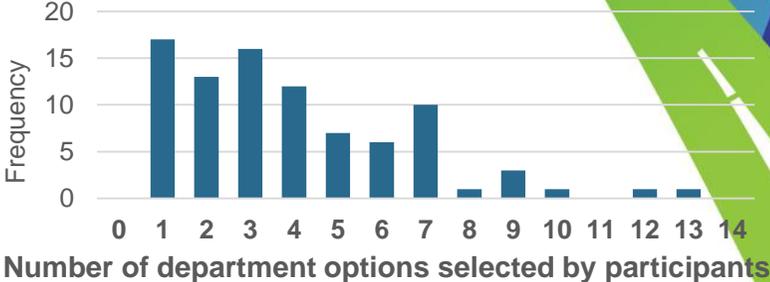
Many departments within an organisation are involved in innovation, but R&D functions dominate

Survey Results – Internal Factors & Barriers

Which departments are involved in innovation and commercialisation of RTD?



Block area represents popularity in survey results



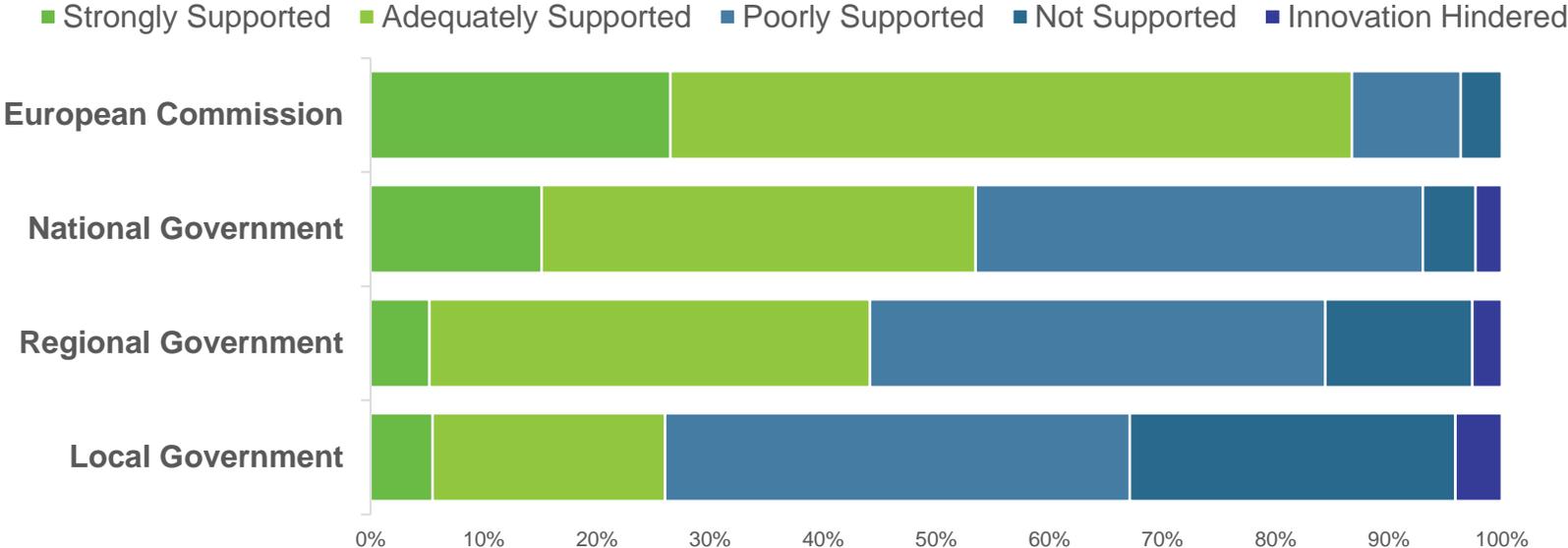
According to the survey results, many departments within an organisation are involved in technology innovation and RTD commercialisation, with most participants selecting 2 or more departments. The most commonly selected department was R&D, probably due to this department’s role in the RTD project. However, it was not clear from the survey results how innovation flows from R&D to other departments as the technology progresses towards commercialisation



Most participants agree that European and national governments offer useful innovation support, ...

Survey Results – Role of Government

To what extent does government currently promote and support innovation in the road transportation sector?



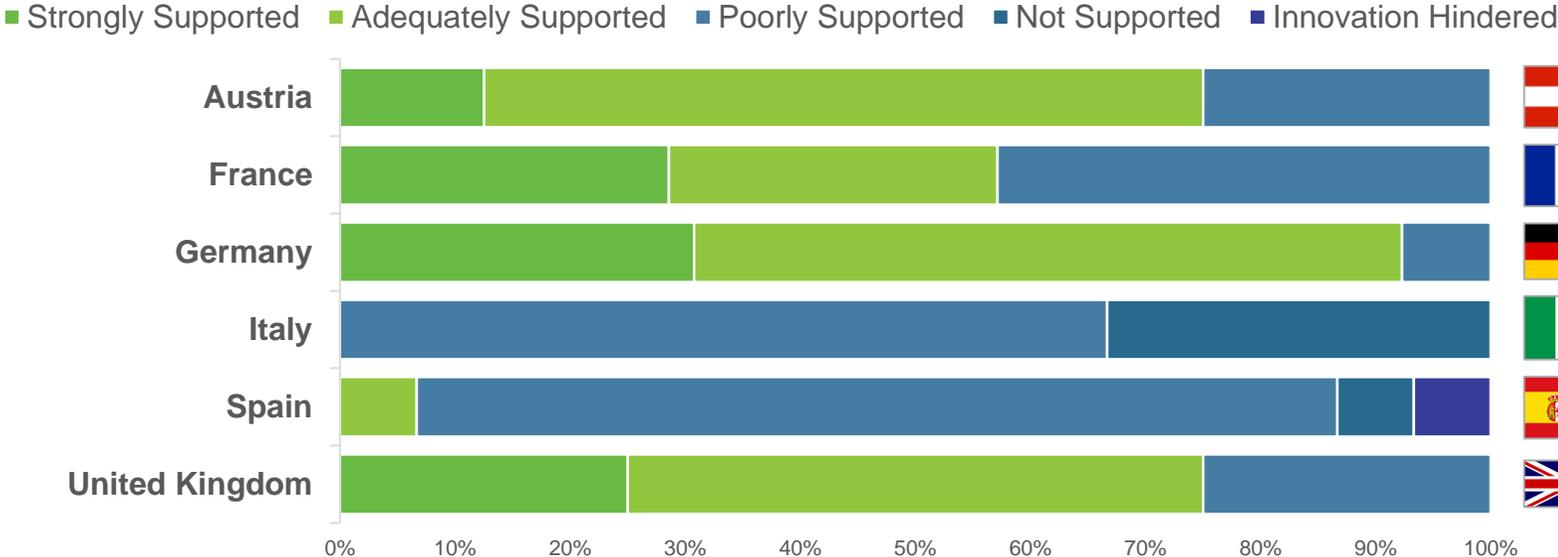
Over 80% of questionnaire participants indicated that the European Commission is adequately or strongly supporting and promoting innovation in road transportation. However, there appears to be less support for innovation at regional and local government levels



... although opinion on national support varies, and correlates with availability of RTD funding

Survey Results – Role of Government

To what extent does government currently promote and support innovation in the road transportation sector?



Italian and Spanish respondents particularly critical

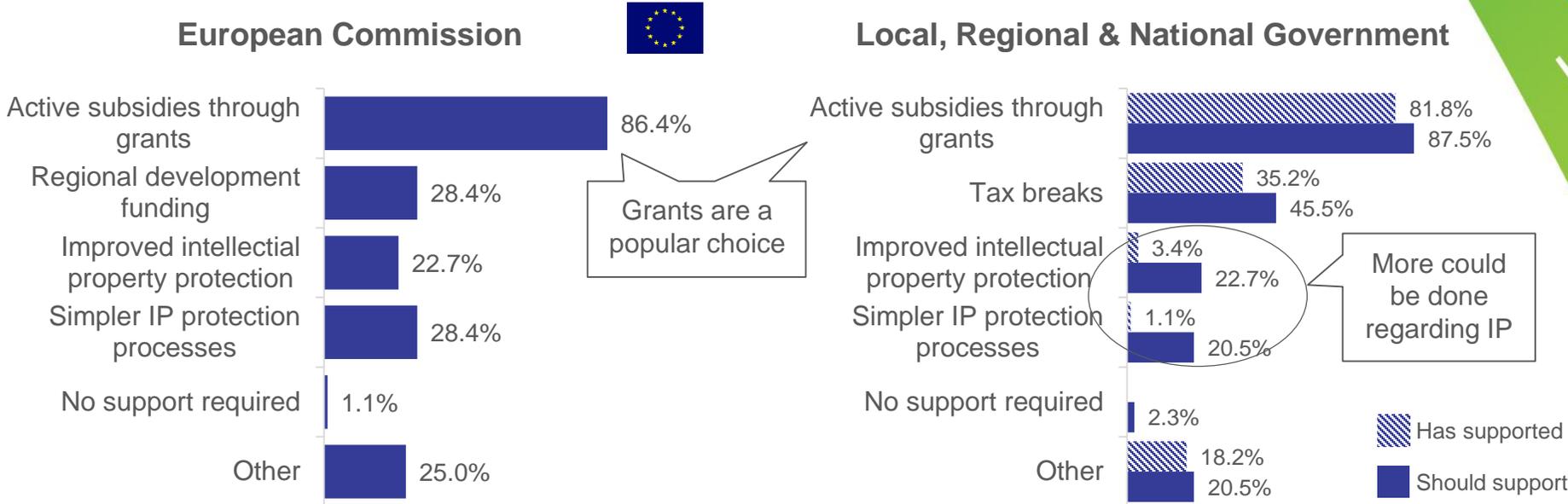
Opinion on national support for innovation varied by country. For example, participants from Austria, Germany and UK generally consider their national governments to be adequately or strongly supporting innovation in the road transport sector. However, the opinion was the opposite for participants from Spain and Italy. Participants from both Spain and Italy commented on significant cuts to RTD funding over recent years, which may explain these strong opinions regarding lack of national support



Subsidies through grants and tax breaks are viewed as popular mechanisms for innovation support

Survey Results – Role of Government

In what ways should government support innovation and RTD commercialisation?



Most participants thought the European Commission and national governments should continue to support innovation by providing **active subsidies through grants**. **Tax breaks**, offered by national governments, were another popular mechanism for supporting innovation. There were also indications that some participants thought more could be done nationally to **improve IP protection and processes**.

Other options to support innovation voiced by participants included RTD funding, promoting fleet trials, risk-sharing finance and use of legislation.



Legislation has a strong role to play in innovation – it can encourage innovation or act as a barrier

Role of Legislation

Legislation that has driven innovation

- + Tailpipe emissions
- + CO₂ reduction
- + Safety requirements
- + Low emission zones in cities
- + Noise reduction



Legislation that has hindered innovation

- “Worthlessness of NEDC”
- Weights and Dimensions
- Vehicle End of Life Directive limits use of polymer composites
- Fuel Quality Directive - renewable target not backed up with alternative fuels certification
- Vienna Convention - limiting automated driving
- Lack of harmonisation across Europe



SELECTED EXAMPLES

“In general, the environmental legislation has been a key driver for environmental innovation in the road sector.”

“Legislation is often in favour of the driver and not of the system design”

Participants had several opportunities within the survey to comment on the impact of legislation on innovation. Many participants comments on the success of target-based legislation, such as tailpipe emissions and fleet average CO₂, in driving innovation in the road transport sector. However, participants also highlighted technical legislation that has hindered innovation, through inappropriate test procedures, inherent bias or restricting market introduction



Many other external factors were identified that can support or hinder innovation in road transport

Survey Results – External Factors

Collaboration

- Successful innovation requires successful collaboration across the RTD chain (universities and research organisations to industry), and across the supply chain (suppliers and OEMs to fleet operators and users)

Public Acceptance

- Lack of public awareness and acceptance of new transport innovation can hinder market introduction

Risk

- Perceived high risk in a conservative industry may deter stakeholders from investing in technology development and in bringing the innovation to market

Codes & Standards

- Lack of appropriate standards can delay product innovation. Earlier development of standards, at lower TRLs, within a “whole systems” framework, may help accelerate innovation and market introduction

Cost & Payback

- High costs associated with commercialisation, from technology demonstration to investing in new manufacturing equipment and infrastructure roll-out

Skills

- Suitably qualified people are required to implement and manage innovation

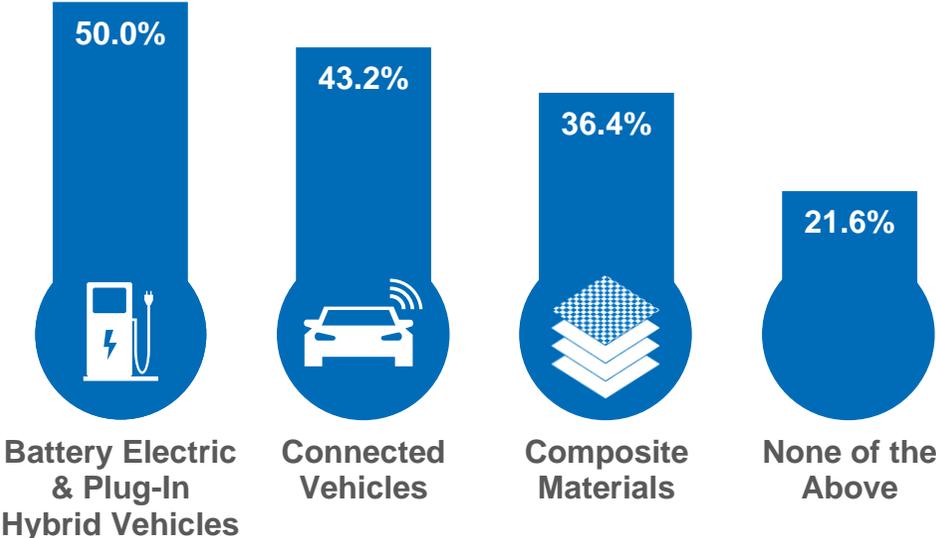
Infrastructure

- Some transport innovations require significant changes to existing infrastructure



Most survey participants had experience in one of the focus areas, providing additional insight into innovation

Survey Results – Selected Focus Areas



In addition to considering innovation within road transport in general, the survey focused on three specific areas:

- Market update of **battery-electric and plug-in hybrid vehicles**
- From **connected vehicles to autonomous** driving in the urban and suburban contexts
- Application of **composite materials** for weight reduction in mass-produced vehicles

Most participants had experience in at least one of these three areas

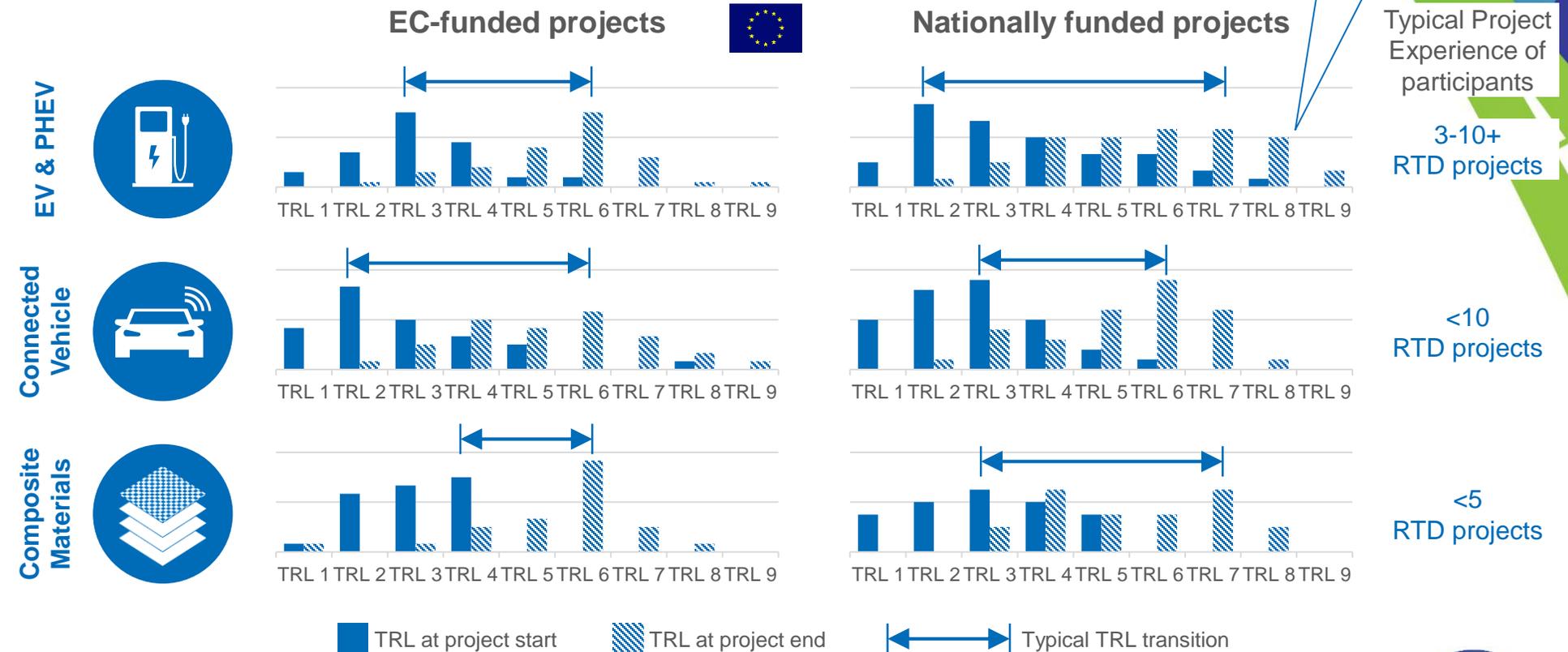


For publically funded RTD projects in the focus areas, the TRL transition is typically TRL 3 to TRL 6

Survey Results – Typical publically funded RTD projects

For publically funding projects, what TRL transition typically took place?

More nationally funded RTD projects with higher TRLs reflects that market uptake of EV and PHEV has already begun



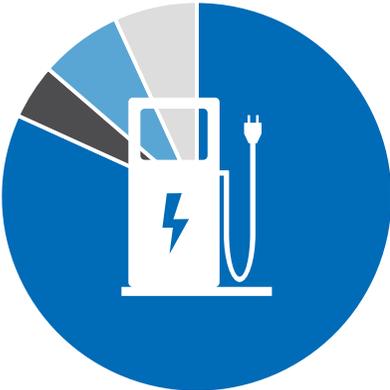
There appears to be some variation in TRL transition between EC-funded projects and nationally funded RTD projects, and between the three focus areas. It may be beneficial to investigate this further in FUTURE-RADAR, the next support action after FOSTER-ROAD



Insight from our three focus areas emphasises the importance of collaboration in driving innovation

Survey Results – Collaboration

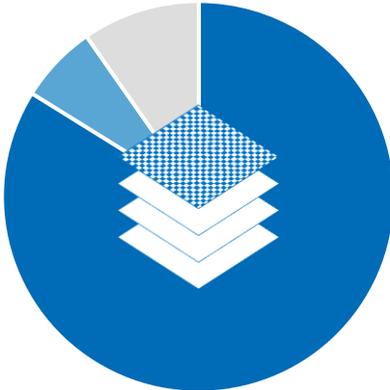
In your experience, does working with other key stakeholders (including competitors) in collaborative projects serve to accelerate or hinder progress towards product innovation?



EV & PHEV



Connected Vehicle



Composite Materials



Most participants, in their experience, thought collaboration helps to accelerate innovation. It enables risks and costs to be shared, and the problems to solve often require multi-disciplinary teams.

The nature of the collaboration is likely to depend on the development stage (TRL). Favourable collaboration for innovation tends to be along the supply and business chains, rather than with competitors. However, collaboration is required to develop standards, which may involve working with competitors



Participants believed incentives, grants & subsidies have driven EV & PHEV innovation and market uptake

EV & PHEV



Specific obstacles and suggested measures to remove them

SELECTED EXAMPLES

Government policy positively influencing innovation +

- + Market incentives, grants & subsidies
- + Installing EV recharging infrastructure
- + Taxation
- + Regulated environmental targets and limits
- + Tailpipe CO₂ targets
- + Low emission zones in cities
- + RTD funding

Government policy negatively influencing innovation -

- Lack of recharging infrastructure
- Non-harmonised regulation
- Bias towards incumbent technologies
- Subsidies not harmonised at a local level
- Focus on tailpipe, not well-to-wheels
- Long decision processes

Measures to remove the obstacles

- More tax on fossil fuels
- Develop long-term strategic European roadmap for reducing emissions, with clearly defined goals
- Support market uptake
- Enable knowledge transfer

Of the participants who responded to questions on government policy’s influence on innovation in road transport, incentives, grants and subsidies, charging infrastructure development and environmental legislation were recurring themes for positively encouraging innovation. Whereas, lack of recharging infrastructure development and non-harmonised regulation were cited as negatively influencing innovation



For connected vehicles, national policy is supporting innovation but legislation harmonisation is required

Connected Vehicle  **Specific obstacles and suggested measures to remove them**

SELECTED EXAMPLES

Government policy positively influencing innovation 

- + Development of Intelligent Transport System (ITS) policy
- + Enabling road testing
- + RTD funding
- + Harmonising regulation
- + Development of security and protocol regulations, codes and standards
- + Developing infrastructure

 **Government policy negatively influencing innovation**

- Legislation that hinders or restricts road testing
- Lack of legislation harmonisation across Europe
- Public safety requirements
- Insurance

Measures to remove the obstacles 

- Harmonise legislation across Europe
- Encourage and enable stakeholder collaboration
- Publically fund RTD and demonstration trials
- Run campaigns to gain public acceptance
- Harmonise standards

Public policy on developing Intelligent Transport Systems (ITS) and national legislation enabling road testing are positively influencing innovation. However, there is a need to harmonise regulations, codes and standards across Europe. RTD funding for demonstration trials will support the stakeholder collaboration required to bring the technology to market



For composite materials, CO2 and safety legislation is driving innovation, but end-of-life directives may create barriers

Composite Materials  **Specific obstacles and suggested measures to remove them**

SELECTED EXAMPLES

Government policy positively influencing innovation +	- Vehicle End-of-Life Directive	Measures to remove the obstacles
<ul style="list-style-type: none">+ Tailpipe CO₂ targets+ Safety requirements+ RTD grants+ Vehicle weight reduction targets	Government policy negatively influencing innovation	<ul style="list-style-type: none">• Develop low cost manufacturing processes• Better coordination and reporting of RTD project results• Set innovation targets for RTD projects• Develop recycling processes

Of the participants who provided opinion on government policy, tailpipe CO₂ targets and safety requirements were recurring examples of positively influencing innovation. Several participants could not think of examples of government policy negatively influencing innovation, although a few commented on the recycling targets in the Vehicle End-of-Life Directive.

RTD funding for developing low cost manufacturing and recycling processes were some of the measures suggested for overcoming the innovation obstacles.



Correlating EC-funded projects with product innovations can be difficult; a number of common reasons exist

Why is it difficult to correlate results of past EC-funded projects with product innovation and success stories?



EV & PHEV



Connected Vehicle



Composite Materials

SELECTED EXAMPLES

Development “gap” between end of RTD project (TRL<7) and market introduction

Product innovations are based on a **series of projects** funded by EC, national programmes, and internal resources

Knowledge transition from R&D to product development

Further investment required to develop innovation

Market Readiness

Confidentiality & IP

Cost of Technology

More collaboration between stakeholders required

Lack of follow-up after the project

"success has many fathers ..."

The participants provided many reasons why it is often difficult to correlate EC-funded projects to product innovation and success stories. Many of these reasons were common across the three focus areas, such as the development “gap” between RTD projects and commercialisation, and many RTD projects contributing to new innovation



In summary: successful innovation requires positive collaboration, time to innovate and a ready market

Final Comments

Success Factors	+
<ul style="list-style-type: none">+ Good collaboration and alliances can accelerate innovation+ Legislation that sets targets drives the need for innovation (e.g. fleet average CO₂)+ Organisations need time to innovate+ Innovation requires a market to be successful	

<ul style="list-style-type: none">- Being “too busy” hinders innovation- Perceived high risk and lack of finance can hinder or stop innovation- Innovation can be lost in the transition from R&D to advanced technology development	
Potential Barriers	

Other Comments	🗨️
<ul style="list-style-type: none">• Bringing innovation to market in the road transport sector requires many stakeholders• Continuing to fund and support technology development through the transition from RTD to innovation could support innovation deployment (e.g. TRL 5-9)• And more fundamental RTD is still required to fill the gaps in knowledge	



The FOSTER-ROAD Innovation Survey has provided useful insights about stakeholder opinion of innovation in ...

Conclusions (1/2)

- The FOSTER-ROAD project has investigated success factors and potential barriers to innovation in European road transport by conducting an online survey to collect opinion and insight regarding RTD commercialisation
 - Between April to June 2016, 88 experts and stakeholders participated in the Innovation Survey, from across the European Union and beyond
- The survey results indicate that organisations are keen to encourage innovation, although lack of time and resources are key issues to overcome
- Most participants thought that the European Commission and national governments did currently support innovation. However, opinion on national support varied by country and appears to be linked to the availability of RTD funding
- Subsidies through grants were viewed as a popular mechanism for the European Commission and national governments to support innovation in road transport. Tax breaks, offered by national governments, were another popular mechanism for supporting innovation. There were also indications that some participants thought more could be done nationally to improve IP protection and processes
- **Legislation has a strong role to play.** It can either encourage innovation through setting challenging targets (e.g. tailpipe emissions and fleet average CO₂) or act as a barrier (e.g. preventing road testing for autonomous vehicles)
- Other external factors were also identified, such as **collaboration, public acceptance, risk, codes and standards, access to finance and payback, access to a suitably skilled workforce, and developing appropriate infrastructure**



... road transport, with specific insights gained on EVs & PHEVs, connected vehicles and composite materials

Conclusions (2/2)

- Most participants had experience in at least one of the three focus areas of the Innovation Survey - market take-up of **battery-electric and plug-in hybrid vehicles**; from **connected vehicles to autonomous driving** in the urban and suburban contexts; and application of **composite materials** for weight reduction in mass-produced vehicles. This provided further insight into innovation in these areas
 - For publically funded RTD projects in these focus areas, the TRL transition is typically TRL 3 to TRL 6
 - Experience from these three focus areas again highlighted the strong role of collaboration in accelerating innovation
 - For EV & PHEV market uptake, incentives, grants & subsidies are seen to have positively influenced innovation
 - For connected vehicles, national policy is supporting innovation but harmonisation of legislation across Europe is required
 - For composite materials, CO₂ and safety legislation is driving innovation but the vehicle end-of-life directive may be a barrier
- Correlating EC-funded projects with product innovations can be difficult for many reasons, such as the development “gap”, many RTD projects contributing to a single innovation, lost in the knowledge transition between R&D to advanced technology development and requirements for further financing
- In summary, innovation success requires **positive collaboration, time to innovate and a ready market**



From the Innovation Survey, the project team has identified several recommendations, as listed below

Recommendations

- **Implement a legislation “challenge model”** – legislation should present a challenge to be solved, not a barrier to overcome
- **Change the perception of innovation** – innovation is not the same as RTD
- **Change the “success measures” for RTD projects**
 - A single RTD project does not necessary lead directly to transport innovation and technology commercialisation
 - However, a successful RTD project should demonstration a technology readiness transition and progression through the RTD to the Innovation chain
- **Investigate extending public funding mechanisms across the RTD and innovation chains**
 - Funding for RTD projects at higher TRLs would help organisations scale the “mountain of risk” and avoid the “valley of death”



Investigation of innovation with the road transport sector will continue in FUTURE-RADAR, the next support action

Next Steps

“The industry would benefit from a deeper study on how innovations actually make their journey through the internal R&D and ... advanced engineering departments, and how EU projects play a role there and how they could play a more effective role. I'm convinced deeper insights in these processes could speed up uptake, may generate new job[s] ..., and ultimately would allow us to reach emission goals quicker.”

- Research activities will continue in FUTURE-RADAR, the next support action, starting in January 2017
- The implementation of innovations will be a key part of FUTURE-RADAR, which includes:
 - Investigation of value chain dynamics in the road transport sector
 - Assessment of national, European and international framework conditions and deployment strategies, in order to strengthen European competitiveness
 - Identification of options to remove barriers for innovation



The FOSTER-ROAD FP7-project is the support action for ERTRAC, the European Technology Platform for road transport (www.ertrac.org). The FOSTER-ROAD project aims to improve the impact of activities in the European research arena for road transport.

The FOSTER-ROAD Innovation Survey has been delivered by AVL, CRF and Ricardo.

AVL (www.avl.com) is the world's largest privately owned company for development, simulation and testing technology of powertrains (hybrid, combustion engines, transmission, electric drive, batteries and software) for passenger cars, trucks and large engines. AVL has about 3500 employees in Graz (including 1500 university graduates) and a global network of 45 representations and affiliates resulting in more than 8000 employees worldwide.

The mission of CRF (www.crf.it) is to develop and transfer innovative powertrains, vehicle systems and features, materials, processes and methodologies and provide expertise in generating innovation in order to improve the competitiveness of FCA products, while supporting FCA in the protection and enhancement of intellectual property.

Ricardo (www.ricardo.com) is a global engineering, environmental and strategic consultancy, working predominantly in the automotive, transport and energy sectors. We have a century-long track record of delivering projects rich in innovation and technology across a range of market sectors.