Transport Research and Innovation Achievements Report 2017

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Transport Research and Innovation Achievements Report 2017

Studies and Reports

European Commission
Directorate-General for Research and Innovation
Directorate H — Transport
Unit H.1 — Strategy

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with the contribution of Blagovesta CHOLOVA
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The 2017 edition of the Transport R&I Achievements Report shows the significant contribution of successfully completed European transport projects to address key policy objectives of the European Union, the potential to turn their outcomes into economic value and their positive impacts on the quality of life of European citizens.

The approach proposed for the 2017 Achievements Report is a step forward compared to previous editions, mainly by demonstrating how investments in Transport R&I under the 7th Framework Programme and Horizon 2020 contribute to achieve the overall policy objectives for ‘clean, connected, competitive and responsible transport’. In other words, there is a clear focus on how Transport R&I at European level contributes to addressing major societal challenges by providing an overview of the funded projects, the partners involved and their major achievements.

The analysis carried out in this Report reflects the increased emphasis put on the innovation potential of EU research activities and on their impact on society and on the economy. This evolution calls for greater attention to the output, outcomes and contribution of EU funded R&I projects and for strengthening the feedback loop of EU R&I activities into policy-making.

The Transport R&I Achievements Report 2017 is the first of a series of annual Reports aiming at bringing forward R&I achievements in transport and at highlighting their policy and societal relevance.

Clara de la Torre
Director for Transport
Directorate-General for Research & Innovation
EXECUTIVE SUMMARY

The Transport Research and Innovation (R&I) Achievements Reports provide a comprehensive analysis of transport R&I results and their contribution towards the fulfilment of major European policy goals. This is the first of a series of annual Reports based on an updated methodology aiming to bring forward the transport R&I major achievements and relate them to the EU policy goals for clean, competitive, connected and responsible transport.

The 2017 edition of this Report, which capitalises on the previous Transport R&I Achievements Reports, analyses 73 projects successfully completed in 2016¹.

Major technological achievements of the projects covered in this Report comprise:

- Considerable number of technologies developed and tested for the electrification of transport, both for road vehicles and aviation. These solutions include the advancement of R&I in the field of replacement of rare-earth materials;
- Demonstration of automated transport technologies and awareness campaigns in several cities across Europe;
- Advancements in design, manufacturing, maintenance and management of infrastructure for aviation and shipping;
- Innovative design solutions for energy-efficient and safe waterborne transport under adverse weather conditions;
- Significant noise reduction of new urban railway track systems;
- New computer-based tools to support strategic planning and decision-making.

The analysis of these completed projects also highlights their contribution to the enhancement of knowledge (scientific and technical outputs) as well as their impact on the economy and the society (notably, jobs and growth).

¹ The projects were funded under the European Commission’s R&I Framework Programmes (including EGVI - European Green Vehicle Initiative and excluding Joint Undertakings).
- More than 65% of the projects developed pilots, tests and demonstrators.

- 256 publications in peer review journals and major international conferences were produced leading so far to 601 citations.

- More than 1000 stakeholders from the industry, research, public and civil society organisations were involved in the examined projects' consortia. Networking, knowledge exchange and dissemination are an added value of the cooperation in EU projects.

- More than 70 new employees were recruited by the project partners for the needs of the projects and still work or worked again for a partner after the conclusion of the projects.

- There were 9 projects carried out in cooperation with third countries, notably with China, Russia, Japan, USA, India, Canada, Israel, Turkey and other countries in Asia, Latin America and Africa.

According to the survey of project coordinators carried out as part of the analysis for the 2017 Transport R&I Achievements Report, a critical issue for transport R&I lays in creating framework conditions to fully exploit the deployment potential of these projects through innovation-friendly regulations, adequate infrastructure, operation and business models as well as behavioural changes.

The Report is structured in 3 parts and related annexes. The scope and the objectives of the analysis are described in the first part. The second part provides aggregated information about the projects and the overview of their achievements. The third part describes in detail the achievements and contributions of the projects by policy goal. The third part presents the overall conclusive remarks of the analysis and the major challenges deriving from the projects. The annexes are dedicated to the description of the methodological approach of the analysis.
1. INTRODUCTION

1.1 Introduction

The Transport Research and Innovation (R&I) Achievements Report provides a comprehensive analysis of transport R&I results and their contribution towards the fulfilment of major European policy goals. More specifically, the Report brings together recently completed European transport R&I projects and assesses their achievements. To this purpose, an achievement is considered as a substantial contribution of a project towards the:

- Creation or enhancement of scientific knowledge;
- Development of new technological solutions or the improvement of existing ones;
- Support in the implementation or assessment of European policy priorities.

1.2 Scope and objectives of the transport R&I achievements report

Capitalising on the previous Transport R&I Achievements Reports, which covered in a cumulative way the European Union’s transport R&I projects completed up to 31/12/2015, the 2017 Transport R&I Achievements Report focuses on European transport R&I projects completed in 2016, notably 73 transport R&I projects completed from 1st January to 31st December 2016. These projects were funded under the European Commission’s R&I Framework Programmes - FPs including EGVI - European Green Vehicle Initiative. The R&I projects of Joint Undertakings are not considered in the analysis.

The projects are grouped in 4 clusters which reflect the main transport policy goals at European level, i.e.: Clean, Competitive, Connected and Responsible Transport. An additional cluster includes projects aiming at disseminating and exploiting R&I results, enhancing networking, supporting strategic planning and policy making for the promotion of sustainable development in different transport R&I sectors. Projects often contribute to a main policy goal, while also affecting or overlapping with other policy goals. These secondary effects on other goals are highlighted in a box called: "Positive synergy with other policy goals".

The projects under each policy goal are categorised by transport mode, R&I focus area and type of actions (according to H2020 actions, i.e.: IA-...

This analysis provides inputs for policy making and the design, implementation and evaluation of research and innovation programmes. In addition to the policy-oriented insight on FP7 and H2020 completed projects, the specific Report is the first of a series of annual Reports that will assess and analyse the potential impact of the EU funded transport R&I projects.

More specifically, the Transport R&I Achievements Report highlights (figure 1):

- Evidence for policy making purposes;
- Trends and future challenges for the strategic planning of transport R&I;
- Major achievements of transport R&I linked to society, industry, market and science;
- New data and information for projects\(^3\).

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\(^3\) Collected by the dedicated Transport R&I Achievements Report Questionnaire Survey to project coordinators and the project-by –project publication and citation search
2. ANALYSIS OF TRANSPORT R&I PROJECTS

2.1 Overview of examined transport R&I projects

The 2017 Transport R&I Achievements Report covers 73 transport R&I projects funded under the European Commission’s Framework Programmes for R&I, successfully completed in 2016. The Report also includes the projects funded under the Public-Private Partnership “European Green Vehicle Initiative – EGVI”, formerly “European Green Cars Initiative – EGCI”. It does not include the projects under Joint Undertakings.

The projects were selected following transport calls published from 2007 to 2014 under the relevant Framework Programmes, i.e. 69 projects under the 7th Framework Programme (FP7) and 4 projects under Horizon 2020 (H2020). The number of projects by their starting year is presented in figure 2, which shows that **more than 80%** of the projects have a duration of 3-4 years.

![Figure 2. Distribution of the number of projects by starting year](image)

According to figure 3, **38%** of projects are clustered under the policy goal "Clean Transport" and almost **29%** under the "Competitive Transport" one. The projects under policy goal "Responsible Transport" represent **14%** of the total. The share of projects exploring innovative solutions based on connectivity and automation technologies (policy goal "Connected Transport") is less than **7%**, as topics relevant to this field gained importance in H2020; only 4 H2020 projects completed in 2016 are included in this Report.
Figure 4 presents the distribution of the cost of the projects by main policy goal. According to the figure, the total cost of the 73 projects is above €516 million. The EU contribution represents 65% of this total cost, i.e. €335 million. The distribution of the projects by cost shows that the cost of projects addressing the policy goal "Competitive Transport" is particularly high, mainly due to the inclusion of large aviation R&I projects under the specific policy goal⁴.

---

⁴ For example, the 8 years long aviation R&I project MAAXIMUS (More affordable aircraft structure through extended, integrated, and mature numerical sizing, AAT-2007-4.4-01 - Integrated approach to life-cycle based development of aircraft structures), which is clustered under Competitive Transport, has a total cost of €65,103,343, corresponding alone to almost 14% of the total cost of the examined projects under all clusters, i.e. €516,478,331.
Figure 5 represents the distribution of the number of projects by main policy goal and by transport mode. **Half** of the projects carry out R&I activities in the field of aviation and about half of these aviation projects investigate solutions to support primarily the policy goal "Competitive Transport". Another 34% of the projects in aviation address the “Clean Transport” goal.

More than **20%** of the projects are in road transport, representing the second highest share of projects, with almost 70% of them clustered under policy goal "Clean Transport".

**15%** of the projects investigate innovative solutions for urban mobility, logistics and other integrated transport solutions.

Another **10%** refer to maritime and inland waterway R&I projects and **5%** to rail R&I projects.

There are **9** projects involving either bilateral cooperation with **China, Russia** or **Japan** or wider cooperative networks with **USA, India, Canada, Israel, Turkey and other countries in Asia, Latin America and Africa.**
• **Overall outcomes and contributions**

  – *Overview of transport R&I achievements*

  An overview of major transport R&I achievements and their contribution to the policy goals identified in this Report, i.e.: Clean, Competitive, Connected and Responsible Transport, are given in table 1. Projects *aiming at dissemination and exploitation of R&I results and support to policy making* are considered to address all policy goals.
<table>
<thead>
<tr>
<th>Transport modes</th>
<th>Achievements</th>
<th>Policy goals</th>
</tr>
</thead>
</table>
| **Aviation**     | Advanced electro-mechanical actuators with potential for 10-15% reduction in weight and fuel consumption  
                    Design of hybrid aircraft prototype with electrically motorised propulsion and assessment of energy  
                    Combustor improvements with 50% reduction in NOx and cut of development time  
                    Self-healing materials with potential for 50% decrease in operational costs and 60% reduction of the accident rate  
                    Integrated software platform for co-operative design of thermal monitoring, assessment and trade-off evaluation  
                    Remake & rework spare parts for reduction of 30% in cost of complex spare parts and 20% in turnaround time  
                    Testing of a innovative and more efficient approach in anti-icing technology for safer and greener aviation | Clean:  | Competitive:  | Connected:  | Responsible: |
| **Waterborne**   | Technology transfer and resilient safety practices from the aviation to the maritime sector  
                    Guidelines and tools for "green" design of ships for safe navigation in adverse weather conditions  
                    R&I solutions for small and medium size shipyards with potential for reduction of 33% in lead time  
                    Consensus building and Europe wide coordination of the maritime strategic R&I agendas | Clean:  | Competitive:  | Connected:  | Responsible: |
| **Rail**         | Embedded track systems with at least 6 dB(A) noise reduction  
                    Development of cost-efficient, small electric vehicles (e.g. on-board production of electricity for driving up to 30km a day)  
                    Steer tyres performing a reduction in rolling resistance by 20% with positive impact of fuel efficiency  
                    Development of eco-labelling system for road products and infrastructures  
                    Safe, green and flexible electric vehicle battery housing for 30% less weight and less cost in mass-production  
                    Demonstration of automated road transport solutions across 7 cities with over 2000 local residents involved | Clean:  | Competitive:  | Connected:  | Responsible: |
| **Road**         | Development of best-in-class rare-earth materials free electric motor  
                    Design of cost-efficient, small electric vehicles (e.g. on-board production of electricity for driving up to 30km a day)  
                    Steer tyres performing a reduction in rolling resistance by 20% with positive impact of fuel efficiency  
                    Development of eco-labelling system for road products and infrastructures  
                    Safe, green and flexible electric vehicle battery housing for 30% less weight and less cost in mass-production  
                    Demonstration of automated road transport solutions across 7 cities with over 2000 local residents involved | Clean:  | Competitive:  | Connected:  | Responsible: |
| **Integrated transport** | "Wiki" of integrated business cases for transport infrastructure provision, operation and maintenance  
                    Promotion of international cooperation for the future development of competitive logistics supported by IoT  
                    Competition of young transport researchers compete in the context of a well-established EU conference  
                    International events for dissemination and networking in transport R&I  
                    10 new regional networks of cooperation under CIVITAS initiative  
                    Open source strategic transport model is one of the top ten nominations for the German Mobility Award 2017 | Clean:  | Competitive:  | Connected:  | Responsible: |
– **Academic and applied research outcomes**

A total of 256 publications (3.5 publications per project in average) in peer review journals and major international conferences have been so far produced by the examined projects, leading to a total of 601 citations (2.3 citations per publications in average) by October 2017.

48 out of 73 projects (66%) developed pilot, tests and demonstrators.

– **Market oriented outcomes**

According to the data from project coordinators, there are 3 projects leading to patent applications while the survey reveals a significant number of projects leading to innovative products, services, processes and methods.

– **Networks and job creation**

The projects involved 1085 partners in total. The distribution of the partners by policy goal (figure 6) shows that 760 partners (almost 80% of the total) are involved in projects under either "Clean" or "Competitive Transport" goals.

Project coordinators stated that more than 70 new employees were recruited by the partners for the needs of the projects and still work or worked again for a partner after the conclusion of these projects.

![Figure 6. Distribution of the total number of partners involved in the projects by policy goal](image-url)

Total number of involved partners: 1085
2.2 Analysis under policy goal "Clean Transport"

The policy goal "Clean Transport" includes transport R&I projects whose primary objective is to develop, test and implement innovative solutions that safeguard environmental sustainability in terms of:

- Climate change mitigation or adaptation;
- Reduction of pollutant emissions, noise and visual disturbance;
- Improvement of energy efficiency and promotion of alternative fuels;
- Balanced development of transport infrastructure and services in relation to land use and
- Promotion of environmentally friendly solutions for urban mobility.

Based on the above criteria, **28 out of the 73** projects are clustered under the policy goal "Clean Transport", corresponding to almost **38%** of the transport R&I projects\(^5\) examined in this Report. This reflects the importance attributed by the European Commission to R&I in order to address transport decarbonisation, both in the various parts of the Transport Work Programmes under FP7 and H2020 and through the European Green Vehicle Initiative (EGVI)\(^6\).

All projects under “Clean Transport” were selected in Transport calls published **from 2010 to 2013**. A total of **399** partners were involved in the consortia.

A total of **5 projects involve international cooperation**.

In figure 7, the projects are distributed by **transport mode** and by **type of action**, i.e. Innovation Action (IA), Research and Innovation Action (RIA) and Coordination and Support Action (CSA). The majority of projects address the increasing environmental challenges in road transport and aviation. Most of the projects (**17 projects**) are **RIA** while there are **7 IA projects** (4 of which regarding electric cars).

\(^5\) FP7 or H2020 Transport R&I Projects under the responsibility of a Directorate General, i.e. DG RTD and DG MOVE, or a PPP, i.e. EGVI (ex-EGCI).

\(^6\) EGCI is a Public-Private-Partnership initiative created in an ad-hoc manner in the 7th Framework Programme, in response to the global economic crisis of 2008. In 2014 the Public Private Partnership (PPP) was re-established as the European Green Vehicle PPP.
The total cost of the R&I projects clustered under "Clean" Transport is over **€157 million**, with an EU **contribution of 63%**. The total cost by **type of action** in figure 8 shows that RIA projects absorb **more than half** of the total cost, while **the other half** goes to IA projects and **less than 5%** to CSA projects.

---

7 The high percentage for the IA projects can be partially attributed to the 6 years long project ACTUATION2015 (Modular Electro Mechanical Actuators for ACARE 2020 Aircraft and Helicopters: AAT.2011.4.4-5. - Integrated modular actuation systems for the future all-electric aircraft, RTD) whose cost (€34,373,652.85) corresponds to 1/5 of the total cost of the projects under policy goal: "Clean Transport".

---
According to figure 9, **half** of the participating organisations are higher education institutions and research organisations. SMEs and large enterprises together represent another **40%**. Public bodies represent **4%** of the participating organisations and are involved mostly in CSA projects.

![Figure 9. Policy goal “Clean Transport” – Distribution of participants by type of organisation](image)

- **Overall outcomes and contributions**

  - **Overview of transport R&I achievements**

  An overview of major transport R&I achievements under the policy goal "Clean Transport" is given in box 1.
Box 1. Major transport R&I achievements to support the "Clean Transport" policy goal in:

Aviation

Contribution to future all-electric aircraft:
- Delivery of 4 Electro Mechanical Actuators and 10 standardised EMA modules.
- Partnership of 53 organisations from different sectors.
  *ACTUATION2015*
- Development of a hybrid propulsion aircraft.
- Flight simulation software for assessing battery performance and energy profiles.
  *HYPSTAIR*

Green combustion engines:
- Demonstrated combustor improvement of up to 50% with regard to NOx.
  *IMPACT-AE*

Waterborne transport

Fuel efficiency under adverse weather conditions:
- Revised guidelines and tools to shape ship "green" designs in the post- Energy Efficiency Design Index era by preserving safety in adverse weather condition.
  *SHOPERA*

Rail transport

Railway track noise reduction:
- Embedded track systems reducing noise by at least 6 dB(A) in comparison with the global rolling noise measured on a well-maintained standard track.
  *QUIET-TRACK*

Road transport

Improved rolling resistance:
- Prototype steer tyres performing a reduction in rolling resistance by 20%.
  *LORRY*

Advancement in electrification:
- Low-cost solutions for small electric vehicles, such as on-board production of electricity for driving up to 30km a day.
  *PLUS-MOBY*
- Best-in-class rare-earth free synchronous machine according to both 2016 benchmark for machine constant of mechanical power and torque density.
  *SYRNEMO*
- **Academic and applied research outcomes**

The total number and average of scientific publications in peer review journals and international conferences deriving from the projects under the policy goal "Clean Transport" are presented in table 2\(^8\). The table also includes the total number of citations of these publications and the average per publication number of citations so far (October 2017)\(^9\).

<table>
<thead>
<tr>
<th>Scientific publications</th>
<th>Citations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total number</strong></td>
<td></td>
</tr>
<tr>
<td>114</td>
<td>267</td>
</tr>
<tr>
<td><strong>Publications per project</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Average number</strong></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

Out of the 28 projects under “Clean Transport”, 20 projects are conducting **laboratory tests, validation activities and pilot demonstrations**. During this process, apart from the configuration of research products and results, new tools and methodologies were developed while existing ones were refined.

- **Market oriented outcomes**

Based on the available data, **1 patent application** derives from the projects. According to the questionnaire survey carried out for this Report, all 9 Project Coordinators participating in "clean" transport R&I projects stated that their project developed **innovative products, services, processes and methods**, while 7 of them stated that the outcomes are intended for potential commercial use. The 2 CSA projects do not aim at market-oriented products.

\(^{8}\) There is a high variation in the number of publications per project depending on the type of action, the outcomes and success of the project and the participation of academic researchers in the consortium.

\(^{9}\) It is highly possible that the number of scientific papers will increase in the near future due to the time-consuming process of publishing in peer-review journals, while the number of citations is also expected to rise, given the short time that has elapsed since the publication of the papers.
Networks and job creation

One of the main benefits of the EU funded R&I projects is the creation of strong networks between participants, which often cooperate beyond the duration of the projects. This seems to be confirmed by the project coordinators, who stated that the cooperative networks deriving from their projects continue to operate beyond their completion with the purpose of:

- Further disseminating the project and supporting its results in the industry, academia and administration.
- Conducting follow-up projects capitalising on the initial project's findings.
- Launching other research or professional activities.

Data provided by the respondents to the 2017 Transport R&I Achievements Report Questionnaire Survey show that 30 persons were recruited for the first time in the context of these projects and continued to work or worked again for one of the project partners after the conclusion of the projects. This is indicative of the direct impact of the projects on the creation of jobs.

Analysis of projects by transport mode

Aviation

Half of the projects under the policy goal "Clean Transport" conduct R&I activities in the aviation field (table 3). 8 of them are RIA while 1 is IA and the other 2 are CSA.

Table 3. Policy goal "Clean Transport" - Aviation-related projects listing

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Title</th>
<th>Call</th>
<th>Type of action</th>
<th>Focus area</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTUATION2015</td>
<td>Modular electro mechanical actuators for ACARE 2020 aircraft and helicopters</td>
<td>AAT.2011.4.4-5. - Integrated modular actuation systems for the future all-electric aircraft</td>
<td>IA</td>
<td>Aircrafts, materials, engines and fuel</td>
</tr>
<tr>
<td>RESEARCH</td>
<td>Reliability and safety enhanced electrical actuation system architectures</td>
<td>AAT.2013.8-1. - Coordinated call with Russia</td>
<td>RIA</td>
<td></td>
</tr>
<tr>
<td>HYPSTAIR</td>
<td>Development and validation of hybrid propulsion system components and subsystems for electrical aircraft</td>
<td>AAT.2013.4-1. - Systems and equipment</td>
<td>RIA</td>
<td></td>
</tr>
<tr>
<td>Acronym</td>
<td>Title</td>
<td>Call</td>
<td>Type of action</td>
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<tr>
<td>IMPACT-AE</td>
<td>Intelligent design methodologies for low pollutant combustors for aero-engines</td>
<td>AAT.2010.1.1-3. - Propulsion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TIDE</td>
<td>Tangential impulse detonation engine</td>
<td>AAT.2012.6.3-1. - Breakthrough and emerging technologies</td>
<td></td>
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</tr>
<tr>
<td>ALAMSA</td>
<td>A life-cycle autonomous modular system for aircraft material state evaluation and restoring system</td>
<td>AAT.2012.3.4-2. - Maintenance AAT.2012.4.2-6. - Maintenance and repair</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VIBRATION</td>
<td>Global in flight health monitoring platform for composite aerostructures based on advanced vibration based methods</td>
<td>AAT.2013.4-4. - Maintenance, repair and disposal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TFAST</td>
<td>Transition location effect on shock wave boundary layer interaction</td>
<td>AAT.2010.1.1-1. - Flight physics AAT.2010.1.1-3. - Propulsion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NIOPLEX</td>
<td>Non-intrusive optical pressure and loads extraction for aerodynamic analysis</td>
<td>AAT.2013.1-1. - Flight physics AAT.2013.4-2. - Design systems and tools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CORE-JetFuel</td>
<td>Coordinating research and innovation of jet and other sustainable aviation fuel</td>
<td>AAT.2013.7-2. - Coordinating research and innovation in the field of sustainable alternative fuels for Aviation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GRAIN 2</td>
<td>Greener aeronautics international networking-2</td>
<td>AAT.2013.7-7. - Exploring opportunities and stimulating cooperation in research and innovation with China</td>
<td>CSA</td>
<td>Transport operations and traffic management</td>
</tr>
</tbody>
</table>
Projects addressing aircrafts, materials, engines and fuel

- The project **ACTUATION2015** is an IA and brings together 53 partners from the industry, the research community and the academia. It aims at reducing the overall life cycle costs and improve the reliability of **Electro Mechanical Actuators**, leading also to the reduction of aircraft weight and fuel consumption. In specific, it aims for the replacement of conventional hydraulic systems by electrically powered ones and sets a target of 10-15% reduction in weight and fuel consumption for new generation Electro Mechanical Actuators. Complementing the activities of the Clean Sky JTI by developing and testing new concepts for actuators in a standardised way, this project addresses the objectives of the Vision of European Aeronautics for 2020\(^\text{10}\) for developing future all-electric aircraft.

Positive synergy with other policy goals:

The project ACTUATION2015 clearly sets as priorities the standardisation, cost-efficiency and increased TRL for actuators supporting the "Competitiveness" of European aviation.

- The implementation of the European policy for the low-emission, **all-electric aircraft** of the future is the main scope of the RIA project **HYPSTAIR**\(^\text{11}\). More specifically, the project achieves progress towards the electric aircraft by developing and testing a hybrid aircraft and analysing comparative advantages and disadvantages compared to conventional aircrafts. In addition, the project delivers a human-machine interface, which is suitable for hybrid aircraft, and the HyPSim flight simulator for assessing energy, performance and behavioural features of the hybrid aircraft.

Positive synergy with other policy goals:

The human machine interface for hybrid electric propulsion developed by project HYPSTER provides an essential technical and technological background to be exploited in future market development contributing to the "Competitiveness" of the European transport market.

- The RIA project **IMPACT-AE** focuses on the development of innovative tools and methods for the optimisation of the aircraft’s engine design. It aims at the development of an aero-design process for **low emission combustors**, demonstrating high Technology Readiness Level (TRL) and introducing innovative solutions. IMPACT-AE directly supports the target for 80%

\(^{10}\) [http://www.acare4europe.org/documents/vision-2020](http://www.acare4europe.org/documents/vision-2020)

\(^{11}\) One of the Projects selected to be presented to the EC Research, Science and Innovation Commissioner.
reduction in NOx emissions, set by the Advisory Council for Aeronautics Research and Innovation in Europe (ACARE) for 2020.

- Aiming at lower emissions as well, the project TIDE focuses on the green engine concept. This RIA project aims at developing a new, breakthrough, high speed propulsion system technology based on the principle of pulsed detonating combustion. However, further development is needed in order for the technologies to reach the market. The project is aligned with Flightpath 2050 developed in 2011 by the High Level Group on Aviation Research, which highlights that the environmental protection is a constant driver in the development of air vehicles, but also with the Vision of European Aeronautics for 2020, which stresses out the need for cuts in CO2 and NOx emissions and pursues innovative advancements in design, manufacturing and maintenance.

Positive synergy with other policy goals:

The cut of time in combustor development achieved by project TIDE enhances "Competitiveness".

The following projects focus on the improvement of inspection and monitoring in order to increase energy efficiency, decrease life-cycle costs and reduce emissions:

- The development of advanced sensors for monitoring thermal insulation layers (thermal barrier coatings, TBCs) in high temperatures is the objective of the RIA project STARGATE12. The project contributes to the increase of energy efficiency and the consequent reduction in GHGs through the improvement of sensor technology, which is estimated to bring a decrease of fuel consumption by 500,000 tonnes of kerosene/year, corresponding to 1.5 million tonnes less CO2. Most of the developed technologies demonstrated TRLs close to or at 5.
- The RIA project ALAMSA comprises another case of advancing technologies for improving maintenance. In the field of health monitoring and self-repair technologies, the project delivers a set of novel concepts to be implemented throughout the aircraft life-cycle.
- The RIA project VIBRATION aims at reducing the requirements in "real-world" training and the number of sensors for in-flight health monitoring of composite structures. The project's SHM platform, i.e. a platform based on vibration analysis for monitoring of composite structures, contributes to the evolution of composite materials for aircrafts, and consequently to decrease weight and fuel consumption.

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12 It should be noticed that technical problems led to a 4-month extension of the project's duration.
Positive synergy with other policy goals:

The improvement of maintenance and monitoring aimed by the projects STARGATE, ALAMSA and VIBRATION has also a direct effect on safety covering the "Responsible Transport" policy goal.

In the meantime, the developed technologies contribute to potential cost savings due to less fuel consumption contributing to "Competitiveness".

Research on the field of laminarity and aerodynamics is another European aviation priority to reduce weight and optimise speed:

- The RIA project **TFAST** proves performance and safety improvements in the field of laminarity as well as a potential 10% decrease in fuel consumption by reducing drag.

- Aiming at improving aerodynamics and aeroacoustics design, the RIA project **NIOPLEX** focuses on the development of an innovative flow-pressure diagnostics approach based on pressure measurement by Particle Image Velocimetry (PIV) and Pressure Sensitive Paint (PIV–PSP) combination. An added value of the project is that its outcomes regarding the optimisation of aerodynamic efficiency, noise and fuel consumption are not exclusive to aviation but can be transferred to other sectors, such as road and rail transport and wind energy.

- Regarding alternative fuels and energy efficiency, the expertise brought together by the CSA project **CORE-JETFUEL** provide a holistic assessment of bio fuel state-of-the-art and potential, taking into account aspects of regulation, energy production, cost, technological readiness, R&I funding opportunities etc. The main contribution of the project is the accumulation of knowledge, the identification of knowledge gaps and R&I needs regarding aviation biofuels and the formulation of concrete recommendations for a relevant European research and development roadmap, contributing to the relevant priorities of the aforementioned Flightpath 2050.

Projects addressing aircrafts, materials, engines and fuel – Transport operations and traffic management

- The project **GRAIN 2** is a CSA project that covers the areas of green operations, engines and fuels aiming at the development of large-scale simulation strategies. The project addresses the objectives of Flightpath 2050 regarding GHGs, emissions and noise. It is an international cooperation project with China and identifies key R&I areas of mutual interest. It should be pointed out that the identification of common interests with China is a timely issue due to the ongoing increase of the country's international airborne traffic.
– Waterborne transport (maritime and inland waterways)

Projects addressing vessels, materials, engines and fuel

- The project SHOPERA\textsuperscript{13} is the only maritime RIA project under “Clean Transport” that was completed in 2016. The project addresses, through a series of measurements, tests and case-studies, the issue of the sufficiency of propulsion power and steering devices to maintain the manoeuvrability of ships in adverse conditions, if operating under the IMO guidelines for emissions and more specifically the 2012 Energy Efficiency Design Index (EEDI). Moreover, the project provides tools and evidence for the holistic analysis of "greener operations" without compromising the ship's efficiency, economy and safety. Thus, the project’s scope is compatible with the current European policy and the long-term objective of ‘zero-waste, zero emission’ maritime transport of the EU Maritime Transport Strategy 2009-2018\textsuperscript{14}. At the same time, the project’s added value comprises the developed innovative assessment methodologies and design tools with future exploitation potential.

**Positive synergy with other policy goals:**

The project SHOPERA sets the aspect of safety as criterion for ship manoeuvrability in adverse conditions, creating a synergy with "Responsible" policy goal.

– Rail transport

There are 2 rail transport projects examined under the policy goal "Clean Transport". They are both IA projects, one focusing on new materials for the rolling stock and the other on innovative railway track elements (table 4).

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<tr>
<th>Acronym</th>
<th>Title</th>
<th>Call</th>
<th>Type of action</th>
<th>Focus Area</th>
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<tbody>
<tr>
<td>REFRESCO</td>
<td>Towards a regulatory framework for the use of Structural new materials in railway passenger and freight carbodyshells</td>
<td>SST.2013.5-1. - Technical requirements for the certification of new materials for railway rolling stock</td>
<td>IA</td>
<td>Vehicles, materials, engines and fuel</td>
</tr>
</tbody>
</table>


\textsuperscript{14} http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52009DC0008
Projects addressing vehicles, materials, engines and fuel

- The use of lightweight materials for trains facilitates the increase of their velocity and the overall performance, upgrading the level of service. The objective of the project **REFRESCO** is to set the framework for the implementation of new materials in the railway sector through the evolution of certification processes for rolling stock. In this context, the project focuses on the regulatory framework and standardisation and delivers a detailed overview of current standards that would need modifications and the characteristics on new materials to be defined in the standards.

Projects addressing infrastructure and transport networks

- Focusing mainly but not exclusively on urban railways, the project **QUIET-TRACK** aims at developing track-based solutions for reducing railway **rolling noise** in conditions when track noise is an important part of the global pass-by noise, such as low speed segments. As noise comprises a major negative impact of **urban railway systems** according to the European White Paper on Transport\(^\text{15}\) and the Green Paper on Urban Mobility\(^\text{16}\) and a main priority for the upgrade of the urban environment according to the updated assessment guidelines of the Environmental Noise Directive\(^\text{17}\), the project delivers innovative solutions for noise reduction and management.

**Positive synergy with other policy goals:**

Towards the development of innovative solutions for noise mitigation, the project **QUIET-TRACK** delivers tools to pre-assess the economic viability of track maintenance promoting, thus supporting "**Competitiveness**".

There are 11 road transport projects examined under policy goal "Clean Transport", two of which are IA projects and the rest RIA projects (table 5). The projects focus on the vehicle, either truck or electric passenger car, in order to optimise the engine, the tyre or other vehicle features and to improve the environmental and energy performance. The projects were launched in 2012 and 2013 under the European Green Cars Initiative (EGCI\textsuperscript{18}) with the exception of the project ROSANNE, retained under the Transport Call 2013.

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<tr>
<th>Acronym</th>
<th>Title</th>
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<tbody>
<tr>
<td>CONVENIENT</td>
<td>Complete vehicle energy-saving technologies for heavy-trucks</td>
<td>GC.SST.2012.2-2. - Complete vehicle energy management</td>
<td>IA</td>
<td>Vehicles, materials, engines and fuel RTD</td>
</tr>
<tr>
<td>SYRNEMO</td>
<td>Synchronous reluctance next generation efficient motors for electric vehicles</td>
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<tr>
<td>ARMEVA</td>
<td>Advanced reluctance motors for electric vehicle applications</td>
<td>GC.SST.2013-2. - Next generation electric motors</td>
<td></td>
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<tr>
<td>VENUS</td>
<td>Switched/synchronous reluctance magnet-free motors for electric vehicles</td>
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<tr>
<td>MAG-DRIVE</td>
<td>New permanent magnets for electric-vehicle drive applications</td>
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<tr>
<td>LORRY</td>
<td>Development of an innovative low rolling resistance truck tyre concept in combination with a full scale simulation tool box for tyre performance in function of material and road parameters</td>
<td>GC.SST.2012.2-1. - Extreme low rolling resistance tyres</td>
<td>RIA</td>
<td></td>
</tr>
<tr>
<td>PLUS-MOBY</td>
<td>Premium low weight urban sustainable e-mobility</td>
<td>GC.SST.2013-3. - Future light urban electric vehicles</td>
<td></td>
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<tr>
<td>AMBER-ULV</td>
<td>Automotive mechatronic baseline for electric resilient ultra-light vehicle</td>
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\textsuperscript{18}In 2014 the Public Private Partnership (PPP) was re-established as the European Green Vehicle PPP.
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<tr>
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<th>Call</th>
<th>Type of action</th>
<th>Focus Area</th>
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<tbody>
<tr>
<td>ENLIGHT</td>
<td>Enhanced lightweight design</td>
<td>GC.NMP.2012-2 - Innovative advanced lightweight materials for the next generation of environmentally-friendly electric vehicles</td>
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<tr>
<td>ALIVE</td>
<td>Advanced high volume affordable lightweighting for future electric vehicles</td>
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<tr>
<td>ROSANNE</td>
<td>Rolling resistance, skid resistance, and noise emission measurement standards for road surfaces</td>
<td>SST.2013.5-3. - Innovative, cost-effective construction and maintenance for safer, greener and climate resilient roads</td>
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</table>

Projects addressing vehicles, materials, engines and fuel

- Regarding freight trucks, significant efforts are conducted to develop a "green" truck prototype by the IA project CONVENIENT. These efforts include testing for rolling resistance of tyres, which is also the focus of the LORRY\(^{19}\) and ROSANNE projects. More specifically, the project CONVENIENT delivers 3 different prototype trucks tested under various criteria taking into consideration the vehicle, the driver and the mission. Although the initial target of 30% reduction was not reached, an overall fuel saving of up to 27% was successfully demonstrated by the project. On the other hand, the initial target of the project LORRY for 20% of improvement in rolling resistance was succeeded, contributing to the policy objective\(^{20}\) for fuel efficient, safe and low-noise tyres and examining the interactions between rolling resistance, wet grip and noise, as highlighted by the European Tyre Labelling regulation\(^{21}\). The project ROSANNE adopted a strategic approach by focusing on standardisation guidelines in order to provide and disseminate across Europe and neighbouring countries a common technical basis for the determination of skid resistance, noise emission and rolling resistance.

Positive synergy with other policy goals:

The improvement of energy efficiency in the sector of freight transport by road demonstrated by the projects CONVENIENT, LORRY and ROSANNE brings a positive effect to the sector's "Competitiveness" through opportunities to decrease fuel costs.

\(^{19}\) http://ec.europa.eu/research/infocentre/article_en.cfm?artid=32780

\(^{20}\) http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52011DC0144:EN:NOT

Regarding **electric vehicle design**, research progress was achieved by the low-cost solutions for small four-wheeled vehicles, as proposed by the project PLUS-MOBY\(^{22}\), which capitalised on the experience of the FP7 project WIDE-MOB. Furthermore, the project AMBER-ULV proposes the use of composite materials and an arrangement of two battery packages (a main permanent one and an auxiliary one). The projects’ innovative solutions contribute towards the priorities of the Transport White Paper, the Green Paper on Urban Mobility for green, small and light passenger vehicles and the European Strategy for Low-Emission Mobility\(^{23}\).

**Positive synergy with other policy goals:**

The project PLUS-MOBY sets as a priority to develop a clean but also low cost vehicle design supporting the "**Competitiveness**" of EVs.

The IA projects SYRNEMO\(^{24}\), ARMEVA and VENUS as well as the research conducted by the RIA project MAG-DRIVE address also road transport electrification, and specifically next-generation **motors for electric vehicles**. More specifically, their objective is the development of **innovative alternatives to rare earth magnets** for the motor without compromising the performance of the electric vehicle. The projects adopt different angles and investigate a series of technological solutions, comprising innovative concepts for the replacement of rare-earth magnets and the production of permanent magnets, which are in a very early stage of development, while other solutions are tested with good performance results and high TRLs. For example, quoting the coordinator of the ARMEVA project, "**the SR motor and its integrated powertrain (currently at TRL 6-7) is in product development to be made market ready (TRL9)**".

**Positive synergy with other policy goals:**

In the current situation, the source for the majority of rare-earth metals is China. This leads to the increase of cost and a potential risk for the European electric vehicle industry. Due to this fact, the projects SYRNEMO, ARMEVA, VENUS and MAG-DRIVE bring findings to improve the "**Competitiveness**" of the European EV sector.

\( ^{22} \)http://ec.europa.eu/research/infocentre/article_en.cfm?artid=39097  
\( ^{24} \)http://ec.europa.eu/research/infocentre/article_en.cfm?artid=39058
In order to facilitate the electrification of road transport, the projects ENLIGHT and ALIVE investigate smart solutions in lightweight materials for electric cars. The project ENLIGHT involved the cooperation of EUCAR, CLEPA and EARPA and achieved a total weight reduction of 50% for five demonstrated modules of Electric Vehicle (EV) architecture components. Moreover, the project ALIVE gives evidence that, by implementing the proposed solutions for design and materials, Europe may potentially have a reduction in CO₂ emissions of 422,000 tons per year.

Positive synergy with other policy goals:

The projects ENLIGHT and ALIVE set clear goals for boosting the "Competitiveness" of the European EV market through the cooperation of major stakeholders and the demonstration of product-oriented solutions.

- Integrated transport

Two projects under policy goal "Clean Transport" are categorised as CSA projects dealing with the decarbonisation of transport, in particular in urban environments. The projects were launched in 2013 under the same call (table 6).

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<tr>
<th>Acronym</th>
<th>Title</th>
<th>Call</th>
<th>Type of action</th>
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<tbody>
<tr>
<td>SOLUTIONS</td>
<td>Sharing opportunities for low carbon urban transportation</td>
<td>SST.2013.3-2. - Implementing innovative and green urban transport solutions in Europe and beyond</td>
<td>CSA</td>
<td>Urban mobility</td>
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<tr>
<td>VIAJEOP PLUS</td>
<td>International coordination for implementation of innovative and efficient urban mobility solutions</td>
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</table>

Projects addressing urban mobility

- The projects SOLUTIONS and VIAJEOP PLUS incorporate a wide international cooperation and networking with the common purpose of allocating and assessing innovative solutions for cleaner and more energy efficient urban mobility. They both stimulate the engagement of cities and local authorities and aim at the exchange of know-how and practice between

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25 The Project was presented in COP21 and COP22 for a.

regions of Europe, Asia, Latin America and Mediterranean Partner Countries (MPCs). Apart from the assessment of innovative solutions for urban mobility from different cities, the examined projects contribute to the integration of environmental sustainability and urban mobility policy from the European to the urban level\textsuperscript{27}. Dedicating part of the efforts to Sustainable Urban Mobility Plans (SUMPs), alignment to the Urban Mobility Package\textsuperscript{28} is ensured.

**Positive synergy with other policy goals:**

The focus on sustainable urban mobility and moreover on the SUMPs ensures synergy to "Responsible" (safe and inclusive) urban transport as well as links to urban development and smart city policies.


\textsuperscript{28} [https://ec.europa.eu/transport/themes/urban/urban_mobility/ump_en](https://ec.europa.eu/transport/themes/urban/urban_mobility/ump_en)
2.3 Analysis under policy goal "Competitive Transport"

The policy goal "Competitive Transport" covers transport R&I projects whose primary aim is to enhance the ability of the transport sector to compete fairly and successfully in international markets while rising standards of living, by:

- Reducing costs of industrial, market and operational procedures
- Contributing to employment and upgrade of skills
- Strengthening international competitiveness

A share of 29% of the total number of projects (i.e. 21 out of the 73 transport R&I projects), addresses primarily the policy goal "Competitive Transport". It should be highlighted that 14 of these projects cover aviation related activities, notably design and manufacturing processes.

All projects were selected in Transport calls from 2011 to 2014, with the exception of the project MAAXIMUS which was conducted in the period 2007-2016. A total of 357 partners were involved in the consortia.

3 projects entail international cooperation, notably with partners from USA, Japan and Russia.

The distribution of projects by transport mode and by type of action (figure 10) shows that there are 6 IA projects, 12 RIA projects and 3 CSA projects.

![Figure 10. Policy goal "Competitive Transport" – Project distribution by transport mode and type of action of projects](image-url)
The total cost of these projects is above **€227 million**, with IAs absorbing over 75% of this total. The EU contribution is **63.6%** of the total cost (figure 11).

**Figure 11. Policy goal “Competitive Transport” – Distribution of the total cost of projects by type of action**

According to figure 12, the research organisations and higher education institutions account for approximately **55%** of the total number of partners followed by a strong participation of SMEs and for-profit enterprises (together accounting for almost **40%**). In most of the cases, the participation of public bodies, and especially services and local governance, is limited to CSA projects.

**Figure 12. Policy goal “Competitive Transport” – Distribution of participants by type of organisation**
• **Overall outcomes and contributions**
  
  – *Overview of transport R&I achievements*

  An overview of major transport R&I achievements under the policy goal "Competitive Transport" is given in box 2.
Box 2.
Major transport R&I achievements to support the "Competitive Transport" policy goal in:

Aviation
"Architect cockpit", i.e.:
- Environment for thermal monitoring, assessment and trade-off evaluation through co-operative design by architects, experts and companies.

TOICA

Self-healing materials for self-repairable aerostructures with the demonstrated potential for:
- The decrease of direct operational costs by 50% by 2020

HIPOCRATES

Remake and rework spare parts during the maintenance, repair, and overhaul (MRO) process leading to:
- Demonstrated reduction of costs for complex spare parts by 30%
- Potential decrease of turnaround time by 20%.

REPAIR

Waterborne transport
Prototypes and solutions targeted to improve productivity in small and medium size shipyards with a perspective of:
- 33% reduction in lead times.
- 20% decrease in personnel costs.

SHIYARD

Road transport
Innovative electric vehicle battery housing using thermoplastic materials for:
- 30% reduction in weight.
- 5 times decrease of mass-production cost.
- Adaptable to different vehicle configurations.

OPERA4FEV

Ecolabeling for road products and infrastructures:
- Software tool for road project assessment according to key performance indicators.
- Cooperation with the European Committee for Standardization (CEN) and stakeholders.
- Twinning activities with stakeholders in the United States.

LCE4ROADS

Integrated transport
International cooperation for strategic development of competitive logistics until 2030 by making use of physical internet innovations

MODULUSCHA

"Wiki" of integrated business cases for transport infrastructure provision, operation and maintenance.

BENEFIT
− *Academic and applied research outcomes*

Table 7 summarises the total and per project average number of scientific publications in peer review journals and international conferences and the total and per publication average number of citations to these publications so far (October 2017), deriving from the transport R&I projects under the policy goal "Competitive Transport".

Table 7. Total and average number of scientific publications from projects under policy goal "Competitive Transport"

<table>
<thead>
<tr>
<th>Scientific publications</th>
<th>Citations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number</td>
<td>72</td>
</tr>
<tr>
<td>Publications per project</td>
<td>207</td>
</tr>
<tr>
<td>Average number</td>
<td>3</td>
</tr>
<tr>
<td>Citations per publication</td>
<td>3</td>
</tr>
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</table>

Out of the 21 projects clustered under “Competitive Transport”, **16 projects include laboratory tests, validation activities, case studies and pilot demonstrations.**

− *Market oriented outcomes*

**One patent application** has been filed by a project. According to the results of the questionnaire survey carried out for this Report, the participating coordinators of projects under the policy goal "Competitive Transport" stated that several **innovative products, services, processes and methods** were developed. In many cases industry and market uptake of these products is already in progress.

29There is a high variation in the number of publications per project depending on the type of action, the outcomes and success of the project and the participation of academic researchers in the consortium. Furthermore, due to the time needed for publishing in a peer-review journal, the number of published papers deriving from the projects may increase in the near future. The number of citations is also expected to increase due to the time needed for a publication to circulate in the academia.
- **Networks and job creation**

Coordinators of projects clustered under policy goal “Competitive Transport” consider EU projects as an effective way to develop and/or strengthen cooperation among different organisation at a European and international level.

There are **17 new persons** recruited for the projects' needs and still work or worked again for one of the partners after the conclusion of the projects.

- **Analysis by transport mode**

  - **Aviation**

There are 14 aviation projects under the policy goal "Competitive Transport", i.e. more than 65% of the projects clustered under the specific policy goal. 8 projects are RIAs, 5 IAs and one CSA. Details on the specific topics of the corresponding calls are presented in table 8.

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Title</th>
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<th>Type of action</th>
<th>Focus Area</th>
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<tbody>
<tr>
<td>TOICA</td>
<td>Thermal overall integrated conception of aircraft</td>
<td>AAT.2013.4-6. - Integrated thermal analysis and design for aircraft</td>
<td></td>
<td>Aircraft, materials, engines and fuel</td>
</tr>
<tr>
<td>HIPOCRATES</td>
<td>Self-healing polymers for concepts on self-repaired aeronautical composites</td>
<td>AAT.2013.4-4. - Maintenance, repair and disposal</td>
<td></td>
<td></td>
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<tr>
<td>ESPOSA</td>
<td>Efficient systems and propulsion for small aircraft</td>
<td>AAT.2011.4.4-4. - Integrated approach to efficient propulsion and related aircraft systems for small-size aircraft</td>
<td>IA</td>
<td></td>
</tr>
<tr>
<td>MAAXIMUS</td>
<td>More affordable aircraft structure through extended, integrated, and mature numerical sizing</td>
<td>AAT-2007-4.4-01 - Integrated approach to life-cycle based development of aircraft structures</td>
<td></td>
<td>Production, repair, maintenance and other operations not related to transport operations</td>
</tr>
<tr>
<td>LOCOMACHS</td>
<td>Low cost manufacturing and assembly of composite and hybrid structures</td>
<td>AAT.2012.4.4-1. - Integrated approach and demonstration to lean manufacturing of metal, composite and hybrid aircraft / engine structures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acronym</td>
<td>Title</td>
<td>Call</td>
<td>Type of action</td>
<td>Focus Area</td>
</tr>
<tr>
<td>----------</td>
<td>----------------------------------------------------------------------</td>
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<td>---------------------------------</td>
</tr>
<tr>
<td>I-VISION</td>
<td>Immersive semantics-based virtual environments for the design and validation of human-centred aircraft cockpits</td>
<td>AAT.2013.4-2. - Design systems and tools</td>
<td></td>
<td>Human factors and user-centred innovation</td>
</tr>
<tr>
<td>RBF4AERO</td>
<td>Innovative benchmark technology for aircraft engineering design and efficient design phase optimisation</td>
<td>AAT.2013.4-2. - Design systems and tools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UMRIDA</td>
<td>Uncertainty management for robust industrial design in aeronautics</td>
<td>AAT.2013.4-2. - Design systems and tools</td>
<td>AAT.2013.1-1. - Flight physics</td>
<td></td>
</tr>
<tr>
<td>SHEFAE</td>
<td>Surface heat exchangers for aero-engines</td>
<td>AAT.2012.4-1-6. - Enhancing cooperation with Japan in the field of surface heat exchanger for aero-engines</td>
<td></td>
<td>RIA</td>
</tr>
<tr>
<td>POLARBEAR</td>
<td>Production and analysis evolution for lattice related barrel elements under operations with advanced robustness</td>
<td>AAT.2013.8-1. - Coordinated call with Russia</td>
<td></td>
<td>Production, repair, maintenance and other operations not related to transport operations</td>
</tr>
<tr>
<td>REPAIR</td>
<td>Future repair and maintenance for aerospace industry</td>
<td>AAT.2013.4-4. - Maintenance, repair and disposal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CORSAIR</td>
<td>Cold spray radical solutions for aeronautic improved repairs</td>
<td>AAT.2013.4-4. - Maintenance, repair and disposal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BOPACS</td>
<td>Boltless assembling of primary aerospace composite structures</td>
<td>AAT.2013.3-1. - Human factors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PERSEUS</td>
<td>Promoting excellence and recognition seal of European aerospace universities</td>
<td>H2020 MG-1.6-2014 - Improving skills and knowledge base in European Aviation</td>
<td></td>
<td>CSA Skills and competences</td>
</tr>
</tbody>
</table>

**Projects addressing human factors and user-centred innovation**

- The RIA project **i-VISION** aims at supporting **human factors design and validation** activities in aircraft cockpits, during the early phases of the product life-cycle through knowledge-based, immersive virtual reality technologies. The purpose is the reduction of product development times and cost by decreasing the need for the building of physical prototypes to check
the above-mentioned factors. The project delivers an integrated tool for virtual reality and cockpit design activities. It supports the Vision 2020 policy by providing potential reductions for up to 50% in aircraft development costs and 20% in time-to-market for new aircraft cockpit.

Projects addressing aircraft, materials, engines and fuel

- Targeting innovation in thermal monitoring, assessment and trade-off evaluation, the "architect cockpit" of the IA project TOICA comprises a design platform involving architects, experts and companies to demonstrate how to build the complex representation of the thermal behaviour of the complete aircraft through a series of “plateaus”. During these plateaus, two target aircrafts were considered depending on the expected Entry Into Service (EIS) date, 2020 and 2030+ respectively. The project develops a set of software functionalities ready for implementation and innovative cooling technologies and concepts for aircraft systems with potential for further development and future implementation by the industry. The project contributes to the Vision 2020 policy for integrated and cooperative design and lead-time reductions.
- Another project, which falls into the field of aircraft design, is the RIA project UMRIDA. It supports the integration of Uncertainty Management and Quantification (UM and UQ) and Robust Design methods (RDM) in the virtual prototyping process. The project explores the use of uncertainty based risk analysis to treat large numbers of simultaneous uncertainties. A significant number of test cases are demonstrated by the project.
- The project RBF4AERO addresses the pressing demand for innovation to reduce aircraft development costs and delivery time while constantly optimising design. The project implements a Benchmark Technology software, i.e. an advanced Computer Aided Engineering (CAE) platform fully integrated with High Performance Computing (HPC) hardware and tailored for generic CAE simulations (Computational Fluid-Dynamics (CFD), Finite Elements Analysis (FEA), Fluid-Structure Interaction (FSI), Ice accretion simulations and Adjoint-based optimization.

Positive synergy with other policy goals:

The project RBF4AERO also demonstrates a potential for 3% reduction in fuel consumption contributing to the policy goals of "Clean" aviation.

30 http://www.acare4europe.org/documents/vision-2020
31 http://ec.europa.eu/research/infocentre/article_en.cfm?artid=39216
In the field of innovative materials, the innovation project **HIPOCRATES** takes advantage of the ability of **self-healing materials** to repair their own micro-cracks and breaks in order to minimise maintenance requirements and related costs. The projects delivers an "all in one microcapsule" developing further the **microcapsule** technology; microcapsules with healing agent are added to the composites polymer mix and, when a micro-crack occurs, break to release the healing agent. It also demonstrates combinations of **reversible polymers**, i.e. materials with internal linkages, which will reverse the damage and close a crack upon delivery of an external stimulus such as heat, radiation or electrical induction. A Potential impact of the project is the ability to decrease direct operational costs by 50% by 2020.

**Positive synergy with other policy goals:**

The decrease in accident rates by 60% which is demonstrated by project HIPOCRATES due to the microcapsule technologies has a direct effect on safety covering the "**Responsible**" policy goal.

Focusing on engine development, the innovation project **ESPOSA** aims at the novel design and manufacture technologies for a range of **small gas turbine engines** up to 1000 kW, in order to open completely a new market segment beyond the turboprop market of 400-500 kW engines. Setting a target of 10-14% reduction in direct operating costs and decrease of pilot workload, the project sets the ambition of an attractive market solution for more affordable and accessible small aircraft transport (including aero-taxi, business aircraft and cargo delivery).

The project **SHEFAE** and its follow-up SHEFAE 2 (ongoing H2020 project) are projects open to **international cooperation** with **Japan**. The aim of SHEFAE is to demonstrate an advanced structural **surface cooler** mounted in an appropriate core fairing composite structure, against current adjustments that occupy vital space for other functions such as noise abatement. The project developed and demonstrated an advanced cooler attached on a mount composite structure (MCS), resulting in a competitive design that offers weight savings of 20 % over current state of the art. The lightweight structural surface cooler contributes positively to the reduction of operational costs. This technology for civil aerospace applications in Europe contributes to the goals of the Flightpath 2050 (High Level Group on Aviation Research, 2011).

**Positive synergy with other policy goals:**

The optimal fuel burn and weight reduction achieved by the project SHEFAE leads to a positive impact on fuel efficiency and "**Clean**" aviation.

32 http://ec.europa.eu/research/infocentre/article_en.cfm?artid=37936
Projects addressing production, repair, maintenance and other operations not related to transport operations

- The innovation projects **MAAXIMUS** and **LOCOMACHS** focus on the assembly processes of composite materials. The project MAAXIMUS achieves the cooperation of 54 partners across Europe for 8 years and focuses among other elements on simulating composite material behaviours during damage initiation, propagation and final failure with the purpose of reducing uncertainty and, thus, redundancy and its negative impact on weight, cost and time. The project LOCOMACHS focuses on the elimination of non-added value operations of the lean assembly production system through the integration of existing technologies with missing breakthrough technologies tested by advanced physical and virtual demonstrators. Several new or improved technologies emerge from the project, some of which are implemented by aircraft manufacturers. In addition, within the field of assembling of composite structures, the research project **BOPACS** achieved significant developments towards innovative simulation and analysis methods for certification of bonded joints. Nonetheless, the initial very ambitious targets of the projects were not achieved to the full, highlighting that future R&I on the topic is needed.

- The research and innovation project **POLARBEAR** aims at decreasing the cost of assembly-line airframe sections by investigating novel composite structures for geodesic fuselage barrel manufacturing. This is an international cooperation project with Russia. It adopts a different research approach to complement the efforts of its predecessor, i.e. FP7 project ALASCA, which was also carried out in cooperation with Russia. The sizing algorithms produced by the project are ready for use and purchase as one of the project partners took them forward into their finite element software.

- The research projects **REPAIR** and **CORSAIR** are aiming at innovative research in repair and maintenance with an overall purpose to upgrade services and reduce costs and time. The project REPAIR demonstrates innovative and cost-efficient solutions for the remake and rework of spare parts instead of their replacement with new ones. More specifically, it extends the existing Maintenance, Repair and Overhaul (MRO) workflow management system and supports it with an integrated IT system architecture that boosts automation and cuts lead time and costs. The project CORSAIR focuses on the capabilities of Cold Spray Technology for maintenance and repair of aeronautic frames and components with the potential to enhance the quality and life span of aeronautical systems and reduce the costs and time in the MRO workflow. The project demonstrates an innovative product, i.e. the (Trans) portable high-pressure cold spray device.

33Flexible tolerancing of composite structure using Anatoleflex; Statistical non-rigid variation simulation of composites in RD&T; Thickness adaption & US laminate thickness control; Air coupled ultrasonic transducers, inspection equipment, probes and generator for NDT; Laser surface treatment for increased bond strength; Fastening end-effector; Predictive gaps simulation for robotic additive manufacturing shimming using low cost precision metrology; Electric tooling for best-fit positioning of ribs and front spar, HEXAPOD.

34http://ec.europa.eu/research/infocentre/article_en.cfm?artid=34979
Both REPAIR and CORSAIR contribute towards the expectation for higher maintenance standards set by the Vision 2020 strategy\(^\text{35}\).

\textbf{Projects addressing skills and competences}

- The project \textbf{PERSEUS} aims at contributing to safeguarding highly skilled aero-engineering workforce and the enhancement of mobility of \textit{aerospace students and graduates} across Europe. It develops the required learning outcomes and competence profiles for aero-engineering curricula and proposes the aerospace specific quality criteria that would complement the existing accreditation systems. The project involves 21 universities, 4 research establishments, 25 EU companies and 2 accreditation agencies across 15 EU Member States.

- \textit{Waterborne transport (maritime and inland waterways)}

There are two projects clustered under the policy goal "Competitive Transport" in the waterborne sector. One is a research (RIA) project focusing on "smart" small and medium sized shipyards. The other is a coordination and support (CSA) project, which addresses the increasing requirements for skills and specialisation of port workers. Details on the specific topics of the corresponding calls are presented in table 9.

\begin{table}[h]
\centering
\begin{tabular}{|l|l|l|l|l|}
\hline
\textbf{Acronym} & \textbf{Title} & \textbf{Call} & \textbf{Type of action} & \textbf{Focus Area} \\
\hline
SMARTYARDS & Developing smart technologies for productivity improvement of European small and medium sized shipyards & SST.2013.5-2. - Low cost flexible automation and mechanisation in small to medium shipyards & RIA & Infrastructure and transport networks \\
\hline
EU-PORTRAITS & European portworkers training scheme & SST.2013.6-2. - Towards a competitive and resource efficient port transport system & CSA & Human factors and user-centred innovation \\
\hline
\end{tabular}
\caption{Policy goal "Competitive Transport" - Waterborne-related projects listing}
\end{table}

Projects addressing infrastructure and transport networks

- The project **SMARTYARDS** targets the improvement of **productivity of European small and medium sized shipyards** under the pressure of global competition. The project concentrates on innovative tools and solutions ranging from improved distributed design and simulated planning to flexible welding equipment and a portable container workshop, but also the drafting of catalogues of innovative materials. The project estimates that the wide range of proposed solutions can reduce a company's personnel cost and process lead times by about 20% and 33% respectively.

Projects addressing human factors and user-centred innovation

- The project **EU-PORTRAITS** aims at strengthening the competitiveness of EU ports by investing in the development of **well-trained and competent work-force**. The project sets 2030 as its horizon for assessing future requirements in human resources, develops the corresponding guidelines on training in the port sector and for EU ports and produces an analysis on Port Labour Regimes in the EU Member States.

Road transport

There are two road transport R&I projects clustered under the policy goal "Competitive Transport". The one is a research and innovation action (IA) and the other a research (RIA) project. The IA project focuses on the field of battery rack manufacturing while the RIA project investigates methods for the eco-labelling of road products. Details on the specific topics of the corresponding calls are presented in table 10.

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Title</th>
<th>Call</th>
<th>Type of action</th>
<th>Focus Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPERA4FEV</td>
<td>Operating rack for full-electric vehicle</td>
<td>GC.SST.2011.7-7. - Advanced eco-design and manufacturing processes for batteries and electrical components</td>
<td>IA</td>
<td>Vehicles, materials, engines and fuel</td>
</tr>
<tr>
<td>LCE4ROADS</td>
<td>Life cycle engineering approach to develop a novel EU-harmonized sustainability certification system for cost-effective, safer and greener road infrastructures</td>
<td>SST.2013.5-3. - Innovative, cost-effective construction and maintenance for safer, greener and climate resilient roads</td>
<td>RIA</td>
<td>Infrastructure and transport networks</td>
</tr>
</tbody>
</table>
Projects addressing vehicles, materials, engines and fuel

- The project OPERA4FEV is the only project in road transport with a primary focus on "Competitiveness". It aims at the development of a cost effective innovative thermoplastic battery rack, which is able to integrate any type of cylindrical cells and can be adaptable to any full electric car models. The project proposes a life cycle approach of the product by integrating the assessment and use of recycling materials as well as by addressing road safety and reliability concerns.

Positive synergy with other policy goals:

The eco-friendly design with the use of recyclables examined by the project OPERA4FEV promotes the "Clean Transport" policy goal.

The assessment of road safety aspects adopted by the project ensures compatibility to "Responsible Transport" policy goals.

Projects addressing infrastructure and transport networks

- The project LCE4ROADS develops a new EU eco-labelling system for road products and infrastructure. More specifically, the project delivers a certification system supported by a methodology and a software tool for the assessment of the sustainability performance of road projects using key performance indicators and a compendium of guidelines with recommendation for greener, safer and cost-effective products. The project partners cooperate with the European Committee for Standardisation (CEN), European national road authorities, sectorial associations, transport laboratories and private companies in the context of dedicated workshops and conduct twinning activities with stakeholders in the United States to benefit from knowledge exchange and further global standardisation.

Positive synergy with other policy goals:

The eco-labelling concept of the project contributes to the "Clean" Road Transport policy goal.
– Integrated transport

There are 3 R&I projects in the field of integrated transport, clustered under policy goal "Competitive Transport" (table 11). 2 of them are RIA projects, investigating standardisation solutions in the logistics chain and developing cost-efficient and innovative production processes for polymer materials in transport respectively. The third project in this specific group is a CSA analysing funding potential and business models for transport infrastructure.

Table 11. Policy goal "Competitive Transport" – Integrated transport-related projects listing

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Title</th>
<th>Call</th>
<th>Type of action</th>
<th>Focus Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODULUSHCA</td>
<td>Modular logistics units in shared co-modal networks</td>
<td>GC.SST.2012.3-1. - Towards sustainable interconnected logistics - development of standardised and modular solutions for freight transport vehicles, loading units and transhipment equipment</td>
<td>RIA</td>
<td>Logistics</td>
</tr>
<tr>
<td>LOWFLIP</td>
<td>Low cost flexible integrated composite process</td>
<td>TPT.2013-1. - Technology transfer in the area of Transport Materials</td>
<td></td>
<td>Materials</td>
</tr>
<tr>
<td>BENEFIT</td>
<td>Business models for enhancing funding and enabling financing of infrastructure in transport</td>
<td>MG-9.3-2014 - Analysis of funding schemes for transport infrastructure</td>
<td>CSA</td>
<td>Infrastructure</td>
</tr>
</tbody>
</table>

Projects addressing logistics

- The project MODULUSHCA is a research and innovation project with the involvement of partners from North America as well as the international Physical Internet Initiative. Its purpose is to provide a basis for an interconnected logistics system for 2030 by enabling operations with developed iso-modular logistics units of adequate sizes for real modal and co-modal flows of Fast-Moving Consumer Goods (FMCG). The project leads to the development of Modular Box Systems that were taken up by industrial initiatives (Consumer Goods Forum) to develop a common standard along the supply chain. The project's scope is also complementary to the activities of the ALICE European Technology Platform (ETP).

Positive synergy with other policy goals:

The facilitation of logistics operations for FMCG through the exploitation of the capabilities offered by the Internet of Things is compatible to the "Connected Transport" policy goal.
Projects addressing materials

- The project **LOWFLIP** sets the goal of developing low-cost, automated production processes for **Carbon Fiber Reinforced Polymer (CFRP)** parts dedicated to structural parts in the aeronautic, truck and automotive sectors. The developed technologies, accompanied by simulation methods, are integrated into full-scale production cells at TRL5, which are demonstrated in parts of the automotive, truck and aeronautic sectors.

Projects addressing infrastructure

- The project **BENEFIT** examines **integrated business models** for the appropriate matching of transport infrastructure provision, operation and maintenance requirements. It aims at the exchange of knowledge and experience and the debate among stakeholders and addresses the current impacts and risks related to the economic and financial crisis but also the innovation opportunities for smart pricing and funding in view of 2050 challenges. The project develops synergies with **COST (European Cooperation in Science and Technology)** Action TU1001: Public Private Partnerships in Transport. The project operates an open-access case study database in a wiki format\(^{36}\).

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2.4 Analysis under policy goal "Connected Transport"

The policy goal "Connected Transport" covers the cluster of transport R&I projects contributing to:

- Improvement of connectivity and information exchange
- Use of ICTs to improve the automation of vehicles and operations

A share of less than 7% of the total number of projects (i.e. 5 out of 73 transport R&I projects examined in this Report) aims primarily at the policy goal "Connected Transport". R&I in the field of connected and automated mobility, which is underpinned by the examined projects of FP7, gains great significance throughout H2020 Framework Programme to become one of the main fields for EU transport R&I today.

All examined projects were launched in FP7 calls in 2012 and 2013. They involved 76 partners, out of which more than half (43 partners) were involved in the project CITYMOBIL2.

The distribution of projects by transport mode and by type of action shows that there are 4 projects each addressing a specific transport modes, i.e. aviation, waterborne, rail, road and one project in the area of integrated transport.

The total cost of these projects is almost €33 million. More than 58% of this cost is attributed to the IA projects and the rest to the RIA projects. The EU contribution is a little less than 66% of the total cost of these projects.

According to figure 13, large enterprises and SMEs represent 42% of the total number of partners while research organisations and higher education institutions account for 34%.

![Figure 13. Policy goal “Connected Transport” – Distribution of participants by type of organisation](image-url)
• **Overall outcomes and contributions**

  – **Overview of transport R&I achievements**

  An overview of major transport R&I achievements under the policy goal "Connected Transport" is given in box 3.

  **Box 3.**

  **Major transport R&I achievements to support the "Connected Transport" policy goal in:**

  **Road transport**

  Automated road transport solutions:

  - Demonstrated in 7 European cities.
  - Evaluated by over 2000 local residents.

  *CITYMOBIL2*

  – **Academic and applied research outcomes**

  Table 12 summarises the total number of scientific publications in peer review journals and international conferences and their average number per project as well as the total and average number of citations per publication so far (October 2017).\(^3\)

  \[^3\]There is a high variation in the number of publications per project depending on the type of action, the outcomes and success of the project and the participation of academic researchers in the consortium. Furthermore, due to the time needed for publishing in a peer-review journal, the number of published papers deriving from the projects may increase in the near future. The number of citations is also expected to increase due to the time needed for a publication to circulate in the academia.
All 5 projects include laboratory tests, validation activities, case studies and pilot demonstrations.

- Market oriented outcomes

According to the results of the 2017 Survey conducted for this Report, the coordinators of the "connected" transport R&I projects stated that their projects contributed to the development of innovative products, services, processes and methods and, more specifically, of automated systems, software and technologies.

- Networks and job creation

One of the main impacts of the projects, according to the project coordinators, was the development of new networks within the industry and the involvement of local public bodies.

Regarding the creation of jobs, 20 new employees were recruited by the partners for the needs of their projects, who still work or worked again for a partner after the conclusion of these projects.

- Analysis by transport mode

- Aviation

Projects addressing aircraft, materials, engines and fuel

- The RIA project RECONFIGURE\(^{38}\) aims at investigating and developing advanced aircraft Guidance, Navigation and Control (GNC) technologies that facilitate the automated handling of off-nominal events and optimize the aircraft status and flight. These technologies will expand current GNC functionalities and alleviate the pilots’ task. The developed GNC technologies and algorithms were tested up to TRL 4. The project builds upon the results of previous projects, such as the FP7 project ADDSAFE.

\(^{38}\) Reconfiguration of control in flight for integral global upset recovery: AAT.2012.3.3-2. - Systems and equipment, AAT.2012.3.4-1. - Design systems and tools.
Positive synergy with other policy goals:

The development of the automated GNC technologies of the project RECONFIGURE is driven by the aircraft’s safety requirements contributing also to the "Responsible Transport" policy goal.

- Waterborne transport (maritime and inland waterways)

Projects addressing transport operations and traffic management – Infrastructure and transport networks

- The project **E-COMPLIANCE** aims at reducing the administrative burden on maritime stakeholders by using semantic technology and digital models to manage regulations. It develops the e-Compliance Creation Tool (web-based text editor for drafting of maritime regulations), a mobile device-based tool for electronic maritime certificates, a ship2port communication tool for exchanging information on local rules and requirements and an on-board Safety Management System. The project demonstrates the potential for the integration of Port Community Systems for sharing data between Port Community Systems (PCSs) in different EU Member States.

Positive synergy with other policy goals:

The techniques and products for better communication and information exchange developed by the project E-COMPLIANCE improve the efficiency of safety management contributing to the policy goal "Responsible Transport".

- Rail transport

Projects addressing vehicles, materials, engines and fuel - Transport operations and traffic management

- The project **EATS** aims at introducing Global Navigation Satellite System (GNSS) based technologies in European Train Control System (ETCS). The project improves the laboratory testing for on-board ETCS equipment and Smart Train Positioning System (STPS) technologies in order to contribute to the implementation of ETCS Level 3.

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39 A European maritime e-compliance cooperation model: SST.2012.5.2-6. - E-Maritime in support of compliance management.

40 ETCS advanced testing and smart train positioning system: SST.2012.5.2-4. - Innovation and standardisation in the field of signalling to accelerate a European Train Control System rollout.
Positive synergy with other policy goals:

A main positive effect from the advanced satellite and wireless technologies developed by the project EAT is the enhancement of railway safety, aligned to the policy goal "Responsible Transport".

Road transport

Projects addressing vehicles, materials, engines and fuel - Transport operations and traffic management – Infrastructure and transport networks - Human factors and user-centred innovation

- The innovation project CITYMOBIL2 is the successor of the FP6 project CITYMOBIL. Its objective is to demonstrate how road vehicle automation can boost sustainable urban mobility. The project also assesses the implementation and legal framework and the wider economic effects of automated urban vehicles. Among other outputs, the project delivers 3 large-scale demonstrations, 4 small-scale demonstrations and 3 shorter events called showcases as well as an extended user survey and awareness campaigns. Involving 43 partners from the sectors of research, academia, private companies and local administration and achieving the implementation of some of the developed services in some cities, the project makes a substantial contribution to the promotion of automated road transport solutions for urban mobility needs and requirements. The project is aligned to the EU Cooperative, connected and automated mobility (C-ITS) policy framework.

Positive synergy with other policy goals:

The project CITYMOBIL2 sets sustainable urban mobility as a goal for the implementation of connected and automated transport solutions, focusing in environmental sustainability and "Clean Transport".

The project also focuses on the social awareness and acceptability of automated transport and addresses safety issues in the context of the "Responsible Transport" policy goal.

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Projects addressing logistics

- Integrated transport

The project CARGO-ANTS is a research and innovation project with the overall aim to develop innovative connected and automated transhipment solutions and provide Europe's ports and terminals with the capability to cope with the continuous growth in global trade under the current strict environmental regulations. The project demonstrates a shared work yard for intelligent Automated Guided Vehicles (AGVs) and automated trucks under specific planning, decision, control and safety strategies. It also delivers a robust grid-independent positioning system and an environmental perception system that oversees operational safety. In this way the project contributes to multitude goals of the EU Maritime Transport Strategy. Moreover, the project brings an unforeseen cross-fertilisation potential, as the developed solutions may serve the needs of other stakeholders beyond container handling, such as warehouses, airports and parking lots.

Positive synergy with other policy goals:

The project CARGO-ANTS uses automation to face increasing global needs for freight transhipments in order to safeguard and improve the "Competitiveness" of ports' and other terminals.

At the same time, the project suggests "Clean Transport" solutions in order to abide with the environmental rules.

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44 http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52009DC0008 (last access on 12/10/2017)
2.5 Analysis under policy goal: "Responsible Transport"

The policy goal "Responsible Transport" covers R&I projects whose primary focus is on the development, testing and implementation of innovative solutions that address:

- Safety for people and freight
- Comfort and quality for the user
- Inclusion and accessibility for all users of the transport system

10 out of the 73 transport R&I projects contribute primarily to the policy goal "Responsible Transport", representing 14% of the total number of projects.

All projects were launched in FP7 calls in 2012 and 2013. A total of 147 partners are involved in these projects.

There is one RIA project open to international cooperation with Japan in aviation.

The distribution of projects by transport mode and by type of action (figure 14) shows that there are 6 RIA projects, 1 IA project and 3 CSA projects. Five of the RIA projects are in the aviation sector.

![Policy goal "Responsible Transport" - Project distribution by transport mode and type of action of projects](image)

Figure 14. Policy goal "Responsible Transport" - Project distribution by transport mode and type of action of projects
The total cost of the projects is **€79 million** with an EU contribution of **67%** (figure 15). RIA projects account for more than **42%** of the total cost, mainly due to the budget of above €30 million of the project ACROSS in the aviation sector.

![Figure 15](image1.png)

**Figure 15.** Policy goal "Responsible Transport" - Distribution of the total costs of projects by type of action

According to figure 16, large enterprises, higher education institutes and research organisations have the **strongest participation** in the partner consortia while the public sector **almost exclusively** participates in CSA projects.

![Figure 16](image2.png)

**Figure 16.** Policy goal "Responsible Transport" – Distribution of participants by type of organisation
- **Overall outcomes and contributions**

  - **Overview of transport R&I achievements**

    An overview of major transport R&I achievements under the policy goal "Responsible Transport" is given in box 4.

    **Box 4.**
    **Major transport R&I achievements to support the "Responsible Transport" policy goal in:**

    **Aviation**
    Anti-icing technologies with improvements for safety and fuel consumption:
    - Demonstrated global ice protection system consisting of individual components to be used separately as well as in combination.
    - Development of lab-scale prototypes de-icing devices with anti-icing coatings.

    **Waterborne transport**
    Transfer of resilient practices for safety from the aviation to the maritime sector:
    - Multi-level resilience model and virtual platform as well as guidelines for marine transport integrating individual, team, multi-party and organisational resilience.
    - Smart procedure methodology in marine operations to identify and assess non-standard procedures.

- **Academic and applied research outcomes**

  The total number of scientific publications in peer review journals and international conferences deriving from the examined cluster of transport R&I projects and the number of citations to these publications are presented in Table 13. The table also presents the average number of scientific publications per project and the average number of citations per publication so far (October 2017).

  ![Table 13](image)

There is a high variation in the number of publications per project depending on the type of action, the outcomes and success of the project and the participation of academic researchers in the consortium. Furthermore, due to the time needed for publishing in a peer-review journal, the number of published papers deriving from the projects may increase in the near future. The number of citations is also expected to increase due to the time needed for a publication to circulate in the academia.
In total, 7 projects included laboratory tests, validation activities, case studies and pilot demonstrations. Some projects developed innovative tools beyond the objective of research in order to facilitate tests and assessment processes.

- **Market oriented outcomes**

There is 1 patent application filed. According to the results of the 2017 Survey carried out for this Report, many of the examined projects lead to innovative products, services, processes and methods, while some of the developed solutions are not intended for commercial use but to support policy-making, e.g. the PLATINA II platform that supports public measures to promote inland waterway transport.

- **Networks and job creation**

Project coordinators stated that the cooperation developed during the project continued beyond its duration. Moreover, they highlighted existing cooperation was enhanced due to the projects.

Regarding the creation of jobs, 4 new employees were recruited by the partners for the projects’ needs, who still work or worked again for a partner after the conclusion of the projects. The number is given on the basis of the replies to the above Questionnaire Survey.
• **Analysis by transport mode**

  - **Aviation**

There are 4 aviation RIA projects, 1 IA project and 1 CSA examined under the policy goal "Responsible Transport". Details on the specific topics of the corresponding calls are presented in table 14.

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Title</th>
<th>Call</th>
<th>Type of action</th>
<th>Focus area</th>
</tr>
</thead>
<tbody>
<tr>
<td>JEDI ACE</td>
<td>Japanese-European de-icing aircraft collaborative exploration</td>
<td>AAT.2012.3.3-6. - Enhancing cooperation with Japan in the field of anti-icing system</td>
<td>RIA</td>
<td>Aircraft, materials, engines and fuel</td>
</tr>
<tr>
<td>SAFUEL</td>
<td>The safer fuel system</td>
<td>AAT.2012.3.3-2. - Systems and equipment</td>
<td>RIA</td>
<td>Aircraft, materials, engines and fuel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AAT.2012.4.2-4. - Systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IDEALVENT</td>
<td>Integrated design of optimal ventilation systems for low cabin and ramp noise</td>
<td>AAT.2012.1.3-2. - Airports</td>
<td>RIA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>AAT.2012.3.1-2. - Noise and vibration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INTERACTION</td>
<td>Innovative technologies and researches for a new airport concept towards turnaround coordination</td>
<td>AAT.2013.2-1. - Airports</td>
<td>RIA</td>
<td>Transport operations and traffic management</td>
</tr>
<tr>
<td>A-PIMOD</td>
<td>Applying Pilot Models for Safer Aircraft</td>
<td>AAT.2013.3-1. - Human factors</td>
<td>IA</td>
<td>Human factors and user-centred innovation</td>
</tr>
<tr>
<td>ACROSS</td>
<td>Advanced cockpit for reduction of stress and workload</td>
<td>AAT.2012.3.5-2. - Integrated approach and demonstration of safe operations under crew peak workload / reduced crew configuration</td>
<td>CSA</td>
<td></td>
</tr>
</tbody>
</table>

**Projects addressing human factors and user-centred innovation**

- The projects **ACROSS** and **A-PIMOD** test innovative flight deck automation and cockpit-based technologies against the increased density of peak workload events for aircraft crews which is expected to derive from the constant growth of air traffic and the strong demand for airlines efficiency. The main objective of the projects is to provide solutions for high-standard
safety and performance conditions covering also the case of intentionally or unintentionally (e.g. due to incapacitation) reduced crew in long haul flight. The main technological solutions developed and tested by the project ACROSS comprise Radio Management Panel, minimised Overhead Panel, touch Interface Control Panel, integrated System Monitoring and Control Crew Monitoring System, Emergency Aircraft Control System and Aircraft Centred Supervision System. The project also investigates the potential for future single-pilot operations to reduce operation costs while maintaining high safety levels. The Project A-PIMOD develops the Multimodal Navigation Display with speech, touch, cursor-control-device or keyboard operation capabilities, the Crew State Inference and a spin-off Training Tool. It proves through extensive validation a 43% reduction potential in the accident rate by constraining human error and contributes to Europe’s strategic vision of reducing the accident rate by 80%.

Positive synergy with other policy goals:

The operational cost diminishment pursued by single-pilot conditions examined by the project "ACROSS" contribute to more "Competitive" aviation.

Projects addressing aircraft, materials, engines and fuel

- The most promising de-icing technologies are selected for the research project JEDI-ACE46 in cooperation with Japan in order to develop an integrated system with the ability to use the technologies either combined or isolated. The system demonstrates improvements in safety management and provision of real time information, while it has the potential of activating automatically, reducing the crew workload. Furthermore, a set of industry oriented materials, tools and systems (ice phobic coatings, electrothermal heating and wing ice protection systems, simulation tools) are tested.

Positive synergy with other policy goals:

A reduction of 1% to 8% in fuel consumption is demonstrated with the corresponding positive impact on emissions brought by the de-icing technologies of the project JEDI ACE contributing to "Clean Transport".

- The purpose of the research project SAFUEL47 is the improvement of safety of the aircraft's fuel system under extreme temperatures, stronger temperature gradients, higher humidity and more frequent exposure to

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lightning. Towards this purpose, the project develops and tests technological solutions with TRLs between 2 and 3 as well as a set of design rules for decreasing the hazard of ice release in the fuel system. It should be highlighted that the project has a cross-fertilisation potential, as its "Water-in-Fuel" Sensor originally designed to measure the quantity of dissolved water in the fuel, can be also used for monitoring the quality of fuel outside the aviation sector, such as the automotive industry and fuel distribution networks, increasing its commercial exploitation potential. A number of monitoring sensors developed by the project and the inerting system are intended for business development in the future.

Positive synergy with other policy goals:
The enhancement of fuel safety brought by the project SAFUEL improves the overall fuel efficiency with positive impact on "Clean Transport" policies.

- While the above projects focus on innovative solutions that improve the aircraft's performance and safety, the research project IDEALVENT addresses the travel comfort conditions and specifically the cabin noise. The project offers new concepts for the design of aircraft ventilation systems leading to reductions in cabin noise of 3-10 decibels. In order to test these concepts, it also develops new techniques for noise measurement and analysis. The project is aligned to the priorities of the Flightpath 2050 for the paramount importance of the passenger and the constant improvement of on-board comfort.

Projects addressing transport operations and traffic management
- The RIA project INTERACTION focuses on the integrated and coordinated management of all turnaround processes for passengers, baggage, freight and ramp operation. The projects adopts a holistic approach by developing a set of innovative information exchange and service provision tools, i.e. e-platforms, apps, management techniques and design solutions (incl. a patent application). These tools were tested in different airports and some of them are going to be commercialised, such as the tool for improving communication and coordination between bodies involved in the airport turn-round and the automatic Passenger Boarding Bridge and cargo vehicle docking. Furthermore, the project develops the appropriate methodologies to assess the impact and performance from their implementation. The overall goal is the improvement of time efficiency

48 It should be highlighted that the reduction of cabin noise levels within the travelers' cabin aims at better comfort conditions and not mitigation of the external impact of transport noise on society. This is the reason for clustering the project under the policy goal "Responsible" and not "Clean" Transport.

contributing to the implementation of the priority of Flightpath 2050 for a streamlined and rapid passage through the airports for passengers and freight.

**Positive synergy with other policy goals:**

The holistic management approach proposed by the solutions of the project are also potential contributors towards a more "**Competitive**" transport management system.

– **Waterborne transport (maritime and inland waterways)**

Two waterborne transport R&I projects are examined under the cluster "Responsible Transport". One is a RIA project for maritime transport, launched in 2013 and the other is a CSA concerning inland waterways, launched in 2012. Details on the specific topics of the corresponding calls are presented in table 15.

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Title</th>
<th>Call</th>
<th>Type of action</th>
<th>Focus area</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEAHORSE</td>
<td>Safety enhancements in transport by achieving human orientated resilient shipping environment</td>
<td>TPT.2013-1. - Technology transfer in the area of Transport</td>
<td>RIA</td>
<td>Human factors and user-centred innovation</td>
</tr>
<tr>
<td>PLATINA II</td>
<td>Platform for the implementation of NAIADIR (PLATINA II)</td>
<td>SST.2012.2.2-2. - Towards an implementation of the NAIADIR Action Areas</td>
<td>CSA</td>
<td>Transport operations and traffic management – Infrastructure and transport networks</td>
</tr>
</tbody>
</table>

Projects addressing human factors and user-centred innovation

- In order to tackle the issue of **human error and shipping safety** in an era of increasing automation, the project **SEAHORSE**\(^{50}\) investigates the most suitable innovative practices from the **aviation sector** and designs the technology transfer to the maritime sector. The project delivers a smart methodology to assess non-standard procedures in marine operations and a multi-level model and virtual platform based on **resilience engineering**. It is worth mentioning that the consortium of SEAHORSE project was awarded

with the international RINA-LR Maritime Safety Award in 2017 for its revolutionary approach\textsuperscript{51}.

**Positive synergy with other policy goals:**

The project SEAHORSE addresses the improvement of safety by decrease human error through practices partially based on automation and "Connected Transport".

The project also addresses the increasing need for multidisciplinary skills in the maritime sector, linked to the increase of automation. In this way, the project support the policy goal "Competitive Transport".

**Projects addressing transport operations and traffic management – Infrastructure and transport networks**

- The CSA project **PLATINA II** involved key-stakeholders in inland waterways for setting up a roadmap for the implementation of the **NAIADES 2 policy package** for the period 2014-2020. It builds on the results of the PLATINA project (2008-2012) which aimed at the acceleration of implementation of the first NAIADES action plan. PLATINA II is the only project exclusively focusing on inland waterway transportation among the projects examined in the current Report.

**Positive synergy with other policy goals:**

The NAIADES 2 policy package includes actions for enhancing fleets and infrastructure but also stimulating the market and creating jobs. By supporting the package, the project PLATINA II contributes also to policy goal "Competitive Transport".

- **Road transport**

**Projects addressing transport operations and traffic management – Infrastructure and transport networks**

The project **VRUITS**\textsuperscript{52} is a CSA project aiming at testing and assessing the impacts of selected Intelligent Transport Systems (ITS) on the mobility of Vulnerable Road Users (VRUs), identifying good practice on the integration of the needs of VRUs in ITS and providing recommendations to policy makers and the industry. The project is included in the list of successful projects of the

\textsuperscript{51} http://cordis.europa.eu/news/rcn/128451_en.html

\textsuperscript{52} Improving the safety and mobility of vulnerable road users through its applications: SST.2008.4.1.4. - Road safety of vulnerable road users in emerging economies.
"Research EU Results Pack: On the move for safer surface transport in Europe". A main achievement of the project is that one of its pilots led to the development of a new market product, i.e. the smart pedestrian crossing "SafeCross".

- Integrated transport

Projects addressing urban mobility

The CSA project OPTICITIES addresses multimodal passenger and freight transport, taking into account the urban mobility and overall urban development regulations and policies as well as the needs and expectations of users, operators and industry. Conducting case studies in 6 European cities, the project examines the potential of data exchange for the implementation of integrated management, smart applications and cross-disciplinary support tools. Thus, apart from the support in the implementation of urban mobility policy, it is aligned with the priorities of Smart Cities and Communities.

Positive synergy with other policy goals:

By promoting multimodality, the project also aims at the decrease of the environmental pressures of congestion contributing to the policy goal "Clean Transport".

By supporting the priorities of smart cities through innovative transport solutions, the project sets the scenery for the implementation of "Connected" urban mobility.


54 http://www.vruits.eu/?q=Videos (last access on 12/03/2018)

55 Optimise citizen mobility and freight management in urban environments: SST.2013.3-1. - Managing integrated multimodal urban transport network.


57 http://ec.europa.eu/eip/smartcities/
2.6 Analysis of projects aiming at dissemination and exploitation of R&I results and support to policy making

Cross-thematic projects aiming at exploitation and dissemination of results as well as at supporting policy making, stimulating networking and enhancing strategic planning are analysed in this chapter. As these projects address the whole spectrum of sustainable transport development, they are considered to equally contribute to all policy goals for Clean, Competitive, Connected and Responsible Transport.

There are 9 out of 73 projects presenting a cross-cutting nature and supporting dissemination, exploitation of results and policy making (12% of the total number of projects). These projects are all implemented via Coordinated and Support Actions. There are 2 projects in aviation, 1 project for each other mode (waterborne, rail and road transport respectively) and 4 projects in the area of integrated transport (figure 17).

![Figure 17. Cross-cutting projects aiming at the dissemination and exploitation of R&I results and the support of policy making - Distribution by transport mode and type of action](image)

All projects were launched in FP7 calls published from 2012 to 2014. 106 partners were involved in the consortia.

The total cost of the projects is more than €20 million with an EU contribution of almost 80% of the total cost. The average contribution is higher than the previous cases due to the type of projects and the inclusion in the analysis of TRA VISIONS 2016 conference with a cost of almost €5 million and 100% EU funding.

According to figure 18, research organisations represent almost 1/3 of the participants while another 1/4 is represented by SMEs. Universities, public bodies and large enterprises together correspond to another 1/3 of the participating organisations.
Figure 18. Cross-cutting projects aiming at the dissemination and exploitation of R&I results and the support of policy making - Distribution of participants by type of organisation

- **Overall outcomes and contributions**

  - **Academic and applied research outcomes**

    The dissemination of research results and innovative solutions is a major priority in many of the examined projects, such as TRA VISIONS 2016, CIVITAS WIKI and AERODAYSUK2015.

  - **Market oriented outcomes**

    According to the results of the 2017 Questionnaire Survey carried out for this Report, several projects are aiming to pave the road for the **up-take of existing innovative transport solutions**. The project HIGH-TOOL is the only project that delivers a **new product**, i.e. an open source tool which is described in detail below.

  - **Networks and job creation**

    Networking is part of the purpose and a main contribution of many projects, such as AIRT-NEXTGEN, MESA-FOSTER WATERBORNE, FOSTER RAIL and FOSTER ROAD. This is reflected in the replies of the above-mentioned Questionnaire Survey, which highlight that the main impact of these projects is the **networking between industrial stakeholders, research leaders and policy makers**.
Regarding the creation of jobs, **5 new employees** were recruited by the partners for the needs of the projects, who still work or worked again for a partner after the conclusion of these projects.

- **Overview of transport R&I achievements**

An overview of major transport R&I achievements of projects aiming at the dissemination and exploitation of R&I results and supporting policy-making is given in box 5.

<table>
<thead>
<tr>
<th>Box 5.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Major transport R&amp;I achievements of projects aiming at the dissemination and exploitation of R&amp;I results and supporting policy making in:</strong></td>
</tr>
<tr>
<td><strong>Aviation</strong></td>
</tr>
<tr>
<td>A European flagship event for R&amp;I in aviation with:</td>
</tr>
<tr>
<td>• Dissemination of key-findings from EU funded research.</td>
</tr>
<tr>
<td>• Setting research goals aligned to EU policy.</td>
</tr>
<tr>
<td><strong>AERODAYSUK2015</strong></td>
</tr>
<tr>
<td><strong>Waterborne transport</strong></td>
</tr>
<tr>
<td>29 stakeholders involved in cooperation to update the maritime strategic R&amp;I agenda through in-depth analysis, foresight activities and showcases.</td>
</tr>
<tr>
<td><strong>MESA-FOSTER WATERBORNE</strong></td>
</tr>
<tr>
<td><strong>Integrated transport</strong></td>
</tr>
<tr>
<td>Young transport researchers compete in the context of a well-established EU conference of international impact.</td>
</tr>
<tr>
<td><strong>TRA VISIONS 2016</strong></td>
</tr>
<tr>
<td>Promotion of CIVITAS initiative for cleaner and better urban transport through 10 regional networks of cooperation.</td>
</tr>
<tr>
<td><strong>CIVITAS CAPITAL</strong></td>
</tr>
<tr>
<td>An open source software is one of the top ten nominations for the German Mobility Award 2017(^\text{58}).</td>
</tr>
<tr>
<td><strong>HIGH-TOOL</strong></td>
</tr>
</tbody>
</table>

• **Analysis by transport mode**
  
  - **Aviation**

  2 aviation projects are clustered under the "Dissemination and exploitation of R&I results and support of policy making" cluster (table 16). One deals with the organisation of a major FP7-Transport event, the Aerodays, and the other one is an H2020 Coordination and Support Action analysing funding schemes for transport infrastructure. The common ground of the projects is their direct reference to strategies to improve the impact of projects’ results in alignment to the goals of EU aviation policy.

  Table 16. R&I projects aiming at the dissemination and exploitation of R&I results and supporting of policy making - Aviation-related projects listing

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Title</th>
<th>Call</th>
<th>Type of action</th>
<th>Focus area</th>
</tr>
</thead>
<tbody>
<tr>
<td>AERODAYSUK2015</td>
<td>Aviation for growth and sustainability</td>
<td>AAT.2013.7-5. - Conference: support for the organisation of Aerodays</td>
<td>CSA</td>
<td>Dissemination actions</td>
</tr>
<tr>
<td>AIRTN-NEXTGEN</td>
<td>Air transport network – next generation</td>
<td>MG-9.3-2014: Analysis of funding schemes for transport infrastructure</td>
<td></td>
<td>Networking actions</td>
</tr>
</tbody>
</table>

**Projects involving dissemination actions**

- The project **AERODAYS 2015** underpins the organisation of the 7th European Aeronautics Days, which is the **European flagship event in aviation** research and innovation taking place once per Framework Programme. 800 visitors joined the 4 days conference, which included poster presentations, briefings and debates, showcases and demonstrations. AERODAYS is a platform allowing for the presentation of the state-of-the-art in the field of European aviation R&I (including SESAR and CleanSky programmes) and the discussion on future R&I priorities and policies.

**Projects involving networking actions**

- The project **AIRTN-NEXTGEN** brings forward the network established under previous AirTN\(^{59}\) projects. More specifically, the project offers a platform for **networking and communication between national organisations and governmental institutions**, develops a database of national funding programmes in Member States and Associated Countries, investigates possible co-funded actions and R&I strategies for smart specialisation and

\(^{59}\) [http://airtn.eu/](http://airtn.eu/) (last access on 12/03/2018)
synergies between Horizon 2020 and European Structural and Investment Funds. The project provides an overview of European research facilities as a basis for coordinating further development to achieve the goals set in Flightpath 2050 developed in 2011 by the High Level Group on Aviation Research.

- **Waterborne transport (maritime and inland waterways)**

*Projects involving in-depth analysis – Dissemination actions – Networking actions*

- The project **MESA - FOSTER WATERBORNE**\(^{60}\) supports the development of an up-to-date strategic R&I agenda in waterborne transport. To this purpose an analysis and assessment of the **research achievements at EU and national level** in the fields of energy efficiency, safety, production, and digitalisation and connectivity (e-maritime) is carried out. Moreover, a set of studies on market, societal and regulatory trends are carried out to support policy developments. Finally, a number of good practices are identified, providing evidence of their impact on commercial exploitation, resource efficiency, environmental benefits, and safety at EU level. It should be highlighted that the project is closely linked and complementary to the projects FOSTER RAIL and FOSTER ROAD, which were launched under the same topic (SST.2013.6-1), as it is described in detail in the following subsections.

- **Rail transport**

*Projects involving in-depth analysis – Dissemination actions – Networking actions*

- The project **FOSTER RAIL**\(^{61}\) is linked to the above-mentioned project MESA and the project FOSTER ROAD presented in the following subsection. This is due to the fact that FOSTER RAIL establishes **an information exchange channel** between these projects and the relevant European Technology Platforms (ETPs)\(^{62}\), the Shif2Rail Joint Undertaking, the ERA-NET partnerships and the Member-States. A session of the TRA (Transport Research Arena) 2014 Conference was dedicated to the project’s findings and results.

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\(^{60}\) Maritime Europe strategy action: SST.2013.6-1. - Strengthening the research and innovation strategies of the transport industries in Europe.

\(^{61}\) Future of surface transport research rail: SST.2013.6-1. - Strengthening the research and innovation strategies of the transport industries in Europe.

\(^{62}\) The examined ETPs are ERTRAC, ERRAC, WATERBORNE, ALICE and ACARE.
Road transport

Projects involving in-depth analysis – Dissemination actions – Networking actions

- The project **FOSTER ROAD** was launched under the same topic with the aforementioned FOSTER WATERBORNE and RAIL. The project identifies promising R&I outcomes of EU funded projects and presents **success factors and barriers for the uptake of R&I** results as well as R&I needs. The project also supports transport related European technology Platforms, notably ERTRAC and enhances synergies and intermodal cooperation with ERRAC, WATERBORNE, ALICE, ACARE.

Integrated transport

There are 4 projects addressing integrated transport R&I, which includes actions relating to the CIVITAS Initiative, the development of the HIGH-TOOL open source integrated model and the EU TRA VISIONS 2016 event (table 17).

Table 17. R&I projects aiming at the dissemination and exploitation of R&I results and supporting of policy making – Integrated transport-related projects listing

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Title</th>
<th>Call</th>
<th>Type of action</th>
<th>Focus area</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIVITAS WIKI</td>
<td>Coordination, dissemination and evaluation of CIVITAS Plus II</td>
<td>SST.2011.3.4-2. - Support action for coordination, dissemination and evaluation, CIVITAS Plus II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CIVITAS CAPITAL</td>
<td>CIVITAS CAPITAL – making the best of CIVITAS!</td>
<td>SST.2013.3-3. - Capitalising CIVITAS knowledge and experience</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HIGH-TOOL</td>
<td>Strategic high-level transport model</td>
<td>TPT.2012.2-1. - Strategic high-level transport model</td>
<td></td>
<td>In-depth analysis</td>
</tr>
</tbody>
</table>

Future of surface road transport European research: SST.2013.6-1. - Strengthening the research and innovation strategies of the transport industries in Europe.
Projects involving dissemination actions – Networking actions

The Transport Research Arena (TRA) conferences have already achieved a decade of successful dissemination and networking as the most significant transport R&I event in the EU. In the framework of TRA 2016, the project TRA VISIONS 2016 undertakes the organisation of 2 competitions for transport research awards in sustainable surface transport. The first is a student competition with the goal of stimulating interest among young researchers and students in the field of sustainable surface transport. The second is a competition for senior researchers in the field of innovative surface transport concepts based on results only from EU-funded projects. In this way, the contribution of the project is twofold: on the one hand, it stimulates participation from young experts bringing publicity and accessibility to their work and, on the other hand, it identifies the champion research teams and the most promising results from EU funded projects.

The CIVITAS initiative was launched in 2002 and focuses on clean and efficient transport in cities. The initiative is strongly linked with the goals of the 2001 and later on the 2011 Transport White Papers\(^{64}\). The projects CIVITAS WIKI and CIVITAS CAPITAL support the CIVITAS Initiative through the demonstration and dissemination activities and measures for cleaner, better transport in cities, the creation of a dynamic knowledge centre and of national and regional networks for the facilitation of the exchanges and transfer of measures based on practical experiences. Among other achievements, the project CIVITAS CAPITAL delivers the continuation of 5 existing and creation of 5 new regional networks.

Projects involving in-depth analysis

The project HIGH-TOOL delivers a strategic model for the pre-assessment of policy measures, preparing the ground for more detailed and, thus, more time consuming and costly models such as TRANSTOOLS and TREMOVE. The integrated analysis includes 7 core modules, i.e.: Demography (DEM), Economy & Resources (ECR), Passenger Demand (PAD), Freight Demand (FRD), Vehicle Stock (VES), Environment (ENV) and Safety (SAF). The project focuses on the policy goals of the 2011 Transport White Paper\(^{71}\) and analyses a roadmap for moving to a competitive low carbon economy in 2050. The model is calibrated against the EU Reference Scenario 2013. The project is linked to the FP7 Project ELTISPLUS, which develops an internet-based service portal on urban transport issues and introduces the concept of Sustainable Urban Mobility Plans within the European transport planning community. The model was short-listed from 170 projects for the 2017 German Mobility Awards and ranked among the top 10.

\(^{64}\) http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52011DC0144
3. CONCLUSIVE REMARKS

The 2017 Transport Achievements Report highlights the central role R&I play to boost Europe’s competitiveness in transport and to address major societal challenges, notably in the fields of climate, environment and energy; safety and security; digitisation; demographic changes, inclusiveness, behaviours and acceptability.

3.1 On the achievements, outcomes and contributions by the projects

- The majority of the examined R&I projects explore new technologies for engines and fuels as well as innovative materials and vehicle design solutions for safer and greener transport. For example, the 50% improvement of aircraft combustor engine with regard to NOx and the on-board production of electricity for a 30 km drive on a small electric vehicle are demonstrated.
- Several projects address competitiveness and efficiency in the fields of production and maintenance. For example, main achievements are the reduction of costs for complex spare parts during aircraft maintenance, repair and overhaul and a 30% lighter electric vehicle battery.
- In addition, the demonstration of automated road transport solutions in 7 European cities is worth mentioning due to the magnitude of the demonstration and the involvement of citizens.
- Many projects developed prototypes, such as:
  - A hybrid propulsion aircraft, Electro Mechanical Actuators and manufacturing technologies in aviation.
  - Technologies for more efficient operations in small and medium scale shipyards.
  - A rare-earth free synchronous reluctance machine and innovative battery housing for electric motors
  - Steer tyres with decreased rolling resistance for heavy-duty road vehicles.
  - Track systems with lower noise emission for urban railways.
- Other projects focus on the establishment of platforms, fora, conferences, etc., for the transfer of knowledge, the exchange of experience and the dissemination of R&I results.
- One of the examined projects delivered an open-source software model for the support of policy makers.
- International cooperation is another important dimension of the projects. There are 9 projects that entail cooperation with partners from North and South America, Asia and Africa. 5 of these projects are clustered under “Clean Transport”, 3 under “Competitive Transport” and 1 under “Responsible Transport”.
- With more than 1000 involved partners from industry, research, public and civil society organisations, the projects’ consortia enhance networking in R&I.
- The examined projects show a positive impact on employment. Many of the employees recruited in the context of the examined projects, still work or worked again for one of the project partners after the conclusion of the projects.
An indication of the importance of the examined projects for academia and researchers worldwide is the significant number of citations on the numerous scientific papers published in the context of the examined projects.

3.2 On major concerns and challenges outlined by the projects

- The Project Coordinators responding to the survey carried out for this Report, give a forward-looking perspective regarding the major concerns and challenges for transport R&I. Most of them put emphasis on the necessity to overcome reluctance from the part of the industry, the decision makers and the travellers to adopt innovative approaches. Reluctance may be due to conservative ways of thinking but also due to the uncertainty about the associated business cases and about the type and extent of future impact from these innovative approaches on society, economy and the environment.
- In addition, some respondents stated that some regulations, the availability and state of infrastructure, the current business and operation models and the existing user behaviours may represent obstacles to the deployment of the proposed innovative solutions.
- Finally, the respondents consider a very challenging task to engage key stakeholders at the European and international level and actively involve them throughout all technology development stages, from low to high Technology Readiness Levels.

3.3 On the relevance of the projects to the support of EU transport related policy

- In order to support scaling-up and deployment of transport innovative solutions at EU level, the European Commission conducts a continuous effort to enhance the synergy between the transport R&I Framework Programme and the Connecting Europe Facility (CEF), which aims at the completion of the Trans-European Transport Network (TEN-T). It should be highlighted that the deployment of new technological solutions is one of CEF’s horizontal policy priorities. Nonetheless, these technological solutions have to be mature enough for wide-scale deployment. Thus, solutions developed in previous Framework Programmes (FP 5, 6 or 7) are often more suitable to support current CEF priorities. Some CEF priorities, which are relevant to the projects examined by this Report, include:
  o Motorways of the Sea (MoS).
  o Aviation safety.
  o Electrification of transport.
  o Freight services and logistics.
  o Intelligent Transport Systems (ITS) and connectivity.
  o Integrated transport and traffic management.
- The projects contribute to addressing EU policy objectives, notably the policy goals of clean, competitive, connected and responsible transport. Often, these projects address more than one of the above policy goals. Therefore,
"positive synergy between policy goals" is highlighted in the Report. Strong synergies exist between the policy goals "Clean Transport" and the other ones (especially "Competitive Transport"). Environmental issues and sustainability are often outlined by the projects as a key aspect of competitive transport. An overview of the "positive synergies between Policy goals" in the examined projects is presented in table below (Table18).

Table 18. Synopsis of the synergies between policy goals

<table>
<thead>
<tr>
<th>Main policy goal</th>
<th>Clean</th>
<th>Competitive</th>
<th>Connected</th>
<th>Responsible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean</td>
<td>Products with strong competitive potential in the &quot;low carbon market&quot;.</td>
<td>Better exchange of data and information to improve environmental performance</td>
<td>Less polluting but also safer, more efficient and more accessible transport solutions.</td>
<td></td>
</tr>
<tr>
<td>Competitive</td>
<td>Eco-friendly design, engine components and materials to increase industrial competitiveness.</td>
<td>Physical internet solutions to integrate logistics operations.</td>
<td>Increased safety through new materials in aviation and electromobility.</td>
<td></td>
</tr>
<tr>
<td>Connected</td>
<td>Connectivity for reduced congestion, higher energy efficiency and more environmental sustainability.</td>
<td>More efficient and less costly management of operations and regulations.</td>
<td>Increase of safety due to less dependence on manual operations and constrain of the &quot;human-error&quot; factor.</td>
<td></td>
</tr>
<tr>
<td>Responsible</td>
<td>Better performance (incl. environmental performance) for vehicles and operations.</td>
<td>Advanced TRL of tools and products with positive impact on job creation.</td>
<td>Real-time data collection and management systems</td>
<td></td>
</tr>
</tbody>
</table>
The European Commission's 2011 Transport White Paper: "Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system" (COM(2011) 144 final) is frequently mentioned by the projects, as this strategic document covering a wide spectrum of transport policy priorities was published very close to the time of their launching. In addition to this strategic document, the projects refer to EU policy documents that address specific priorities and objectives of transport policy, as presented in table 19. The table correlates major achievements by transport mode with their contribution to relevant policy priorities at EU level, as reported by the project coordinators, and, in doing so, it provides a list of key policy documents.

Table 19. Links between the examined projects and EU policy priorities

<table>
<thead>
<tr>
<th>The R&amp;I projects in:</th>
<th>are linked to the policy priorities of:</th>
<th>by contributing to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aviation</td>
<td>High Level Group on Aviation Research, (2011), Flightpath 2050. Europe’s Vision for Aviation. Luxembourg: Publications Office of the European Union, 2011 European Aeronautics: a vision for 2020, meeting society’s needs and winning global leadership.</td>
<td>• Less GHGs, emissions and noise from vehicles and operations. • Evolution of composite materials for aircrafts • Roadmap for R&amp;I on aviation biofuels • Integrated and cooperative design and lead-time reductions • Higher maintenance standards • Improvement of passenger comfort • Coordination between research and flightpath strategies</td>
</tr>
<tr>
<td>Waterborne transport</td>
<td>EUROPEAN COMMISSION COMMUNICATION, (2009), Strategic goals and recommendations for the EU’s maritime transport policy until 2018 (Brussels, 21.1.2009. COM(2009) 8 final)</td>
<td>• Long-term objective of ‘zero-waste, zero emission’ maritime transport • Safer, more efficient and greener port operations</td>
</tr>
<tr>
<td>The R&amp;I projects in:</td>
<td>are linked to the policy priorities of:</td>
<td>by contributing to:</td>
</tr>
<tr>
<td>---------------------</td>
<td>----------------------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>EUROPEAN COMMISSION COMMUNICATION, (2016), European strategy on Cooperative Intelligent Transport Systems, a milestone towards cooperative, connected and automated mobility (Brussels, 30.11.2016, COM(2016) 766 final)</td>
<td>• Demonstration of connected and automated road transport in European cities</td>
<td></td>
</tr>
<tr>
<td>Urban mobility policy</td>
<td>EUROPEAN COMMISSION COMMUNICATION, (2013), Together towards competitive and resource-efficient urban mobility (Brussels, 17.12.2013, COM(2013) 913 final)</td>
<td>• Enhancing the implementation of Sustainable Urban Mobility Plans (SUMPs)</td>
</tr>
<tr>
<td>Model for strategic planning</td>
<td>EUROPEAN COMMISSION COMMUNICATION, (2011), A Roadmap for moving to a competitive low carbon economy in 2050 (Brussels, 8.3.2011 COM(2011) 112 final)</td>
<td>• Development of forecasting tool and supporting of strategic planning for the &quot;low carbon economy&quot; policy targets</td>
</tr>
</tbody>
</table>
4. ANNEXES

4.1 Methodological approach

Figure 19 describes the concept behind the methodology implemented by the Transport R&I Achievements Report. First, the overview of the transport policy framework at the European level led to the identification of specific policy goals. Then, the transport R&I Framework Programmes were analysed in order to allocate the R&I priorities that aim at the above policy goals. Finally, the projects funded under the Framework Programmes and address these R&I priorities were assessed in order to highlight their achievements, investigate the relations between them and identify the future challenges for transport R&I in relevance to the aforementioned policy goals.

![Figure 19](image)

The policy goals and R&I priorities deriving from the above process are presented in table 20. Apart from the policy goals presented in the Table, an additional cluster of projects was examined, which includes projects aiming at...
the "Dissemination and exploitation of R&I results and support of policy making".

<table>
<thead>
<tr>
<th>Policy goals</th>
<th>Clean</th>
<th>Competitive Transport</th>
<th>Connected Transport</th>
<th>Responsible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of the natural and built environment</td>
<td>Quality of the natural and built environment</td>
<td>Economic development &amp; international competitiveness</td>
<td>Cooperative, connected &amp; automated transport</td>
<td>Mobility needs and expectations</td>
</tr>
<tr>
<td>• Climate change</td>
<td>• Climate change</td>
<td>• Industry</td>
<td>• Data &amp; information exchange</td>
<td>• Safety</td>
</tr>
<tr>
<td>• Pollutant emissions</td>
<td>• Pollutant emissions</td>
<td>• Market</td>
<td>• Connectivity</td>
<td>• Reliability</td>
</tr>
<tr>
<td>• Noise / Disturbance</td>
<td>• Noise / Disturbance</td>
<td>• International competitiveness</td>
<td>• Automation</td>
<td>• Capacity</td>
</tr>
<tr>
<td>• Fuels &amp; energy use</td>
<td>• Fuels &amp; energy use</td>
<td>• Employment</td>
<td>• Safety</td>
<td>• Performance</td>
</tr>
<tr>
<td>• Land use</td>
<td>• Land use</td>
<td></td>
<td>• Capacity</td>
<td>• Social inclusion</td>
</tr>
</tbody>
</table>

Under each policy goal, projects are further categorised by transport mode, i.e.:

- Aviation
- Waterborne (Maritime & Inland Waterways-IWW)
- Rail
- Road
- Integrated transport, which refers to projects which do not concentrate on a single transport mode but follow an integrated approach, such as intermodal logistics projects.

For each transport mode, projects are also analysed according to their focus area, i.e. technical areas of the technological solutions developed by the project, such as vehicles, human factors, transport operations, infrastructure and networks, etc.

Finally, information on types of action implementing each project are provided as well, using the types of action of H2020, i.e.:

- Innovation Action (IA) - Projects carrying out activities relating to: prototyping, testing, demonstrating, piloting, large-scale product validation and market replication;
- Research and Innovation Action (RIA) - Projects carrying out research, technology development and small-scale testing;
- Coordination and Support Action (CSA) - Accompanying measures including standardisation, dissemination, awareness-raising, networking, studies etc.
In order to assign the projects by type of actions, the main assumption made is that FP7 L2 actions (technology integration, demonstration and validation) and L0 - L1 actions (new and upstream research) correspond to H2020 IA and RIA respectively.

More detailed analysis on the project clustering and categorisation is given in Annex 4.2, where each project can be assigned to a box within the given table.

It is important to notice that the Report does not provide a quantification of the impact of projects’ R&I achievements on short-term transport policy objectives, as these achievements are not yet scaled-up. However, taking into account that the advancement and maturing of innovation is a main pathway for ultimately reaching long-term transport policy targets, the transport R&I achievements are related to transport policy according to their potential impact if widely deployed.

Data collection

For each project, the following data and information are collected:

- Project details (name, acronym, call, etc.)
- Website link
- Outcomes and results
- Responsible DG or PPP
- Innovative products
- Established cooperation networks
- Partnership details (number and type of participating organisations)
- Number of projects involving conduction of tests, pilots and case studies
- Number of projects involving international cooperation
- Number of sustainable job positions
- Number of patent applications
- Number of publications and their citations
- Budget details (total cost, EU contribution)
- Potential impacts
- Future challenges

The sources used to collect the above data and information are the following:

- European Commission's CORDA database
- Transport R&I Achievements Questionnaire Survey, i.e. a brief questionnaire survey for the collection of data not monitored by the official databases and sources, which are described in the following sub-section. These data and information was directly contributed by the project coordinators. A total of 38 filled-in questionnaires out of 73 sent questionnaires were received. The questionnaire is presented in Annex 4.4.

---

65 See Annex 4.3.
Official internet sources, i.e.:
  - H2020 Participant Portal
  - CORDIS platform
  - R&I information centre's Success Stories
  - Transport Research and Innovation Portal and Transport Research and Innovation Monitoring and Information System
  - European Green Vehicle Initiative website
  - Google Scholar, Scopus, Web of Science and OpenAire and the projects' websites.

The above data and information were used to fill-in the indicators of the *Transport R&I Achievements Indicator Set*, which complement the H2020 Key Performance Indicators (KPIs). More information is available in Annex 4.5.
### 4.2 Clustering and categorisation of examined projects

<table>
<thead>
<tr>
<th>Category</th>
<th>Transport Mode</th>
<th>Main Policy Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Type of Action</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clean</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IA</td>
</tr>
<tr>
<td><strong>Aviation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Waterborne</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Rail</strong></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td><strong>Road</strong></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Integrated</strong></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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</tr>
</tbody>
</table>

Further categorised by focus area, such as:
- Human factors and user-centred innovation
- Aircraft, materials, engines and fuel
- Infrastructure and transport networks
- Transport operations and traffic management
- Production, repair, maintenance and other operations not related to transport operations
- Skills and competences

*These projects do not concentrate on a single transport mode but follow an integrated approach.*
### 4.3 Type and level of data provided by the report

<table>
<thead>
<tr>
<th>Data</th>
<th>Type of data</th>
<th>Level of data reference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Qualitative</td>
<td>Quantitative</td>
</tr>
<tr>
<td>Project details (name, acronym, call etc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Website link</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outcomes and results</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Management on behalf of EC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Innovative products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Established cooperation networks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partnership details (number and type of participating organisations)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of projects involving conduction of tests, pilots and case studies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of projects involving international cooperation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of sustainable job positions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of patent applications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of publications and their citations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of projects and distribution by Policy goal, Type of Action and Transport Mode</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Budget details (total cost, EU contribution) and distribution by Policy goal and Type of Action</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential impacts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Future challenges</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.4 Form of the transport R&I achievements questionnaire survey

FP7 & H2020 Project Survey

European Commission
Directorate-General for Research & Innovation

Project Coordinator Questionnaire Survey

Transport Research and Innovation Achievements Report 2017
The current survey is carried out by the Directorate-General for Research & Innovation of the European Commission for the purpose of collecting data and information regarding recently completed FP7 and H2020 funded research projects in the context of the Transport Research & Innovation Achievements Report.

The Transport R&I Achievements Report aims at analysing the outcomes of completed EU research projects and their contribution to the enhancement of knowledge, the development of innovative transport solutions and the support of EU policy goals. In this way, the Achievements Report provides a substantial input to the design of future European research and innovation priorities.

The ongoing 2017 Achievements Report will analyse FP7 and H2020 projects completed in 2016 while it will be widely distributed to policy makers at the EU and Member-State level and become freely accessible to researchers and transport stakeholders.

By filling in the following questions you will make a significant contribution to the 2017 Transport R&I Achievements Report.

Please give us your name and the name of your Organisation.

Participant's name and SURNAME:

Organisation's name:

Please give us the Acronym of the FP7 Project(s) which your Organisation coordinated and was(were) completed in 2016:

1. Were any innovative products, services, processes and/or methods developed by your project?
   - Yes
   - No

Are these products, services, processes and/or methods intended for commercial use?
   - Yes
   - No

Please specify

2. How many persons, recruited for the first time in the context of your project, still work or worked again for one of the project partners after the conclusion of your project?

3. Was a cooperation between project participants (partners, stakeholders, end users etc.) established beyond the duration of the project?
   - Yes
   - No
4. Looking back, what would you consider as the main impacts of your project?

- [ ] Societal
- [ ] Economic
- [ ] Environmental
- [ ] Research & Innovation
- [ ] Other

Societal impact

Economic impact

Environmental impact

Impact on research and innovation

Other impact

5. What are in your opinion the main future challenges in the field of your project?

Do you want to receive a copy of the 2017 Transport R&I Achievements Report when it will be published?

- [ ] Yes
- [ ] No
### 4.5 Brief presentation of transport R&I achievements indicator set

#### Indicator sub-group: PC. Project Cluster

<table>
<thead>
<tr>
<th>Code</th>
<th>PC.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Distribution of projects and cost per Policy goal (Project Clusters)</td>
</tr>
</tbody>
</table>
| Definition | PC.1.1. The number and share of projects per Policy goal.  
PC.1.2. The total cost and share of EU funding of projects per Policy goal. |
| Scope | It reveals the extend to which the specific Policy goal was addressed. It generates the Project Clusters, i.e. group of projects focusing on each Policy goal |
| Measurement | PC.1.1. Number of projects and percentile share (%)  
PC.1.2. Cost (10^6 €) and percentile share (%) |
| Sources | CORDA platform |
| Remarks | - |

#### Indicator sub-group: CD. Policy goal Analysis - Cluster Description

<table>
<thead>
<tr>
<th>Code</th>
<th>CD.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Distribution of projects and cost per Type of Action</td>
</tr>
</tbody>
</table>
| Definition | CD.1.1. The number and share of projects per H2020 equivalent Type of Action, i.e. I.A. = L2, R.I.A. = L0 & L1 and CSA  
CD.1.2. The total cost of projects per H2020 equivalent Type of Action, i.e. I.A. = L2, R.I.A. = L0 & L1 and CSA. |
| Scope | It shows the weight attributed to research, applied research and coordination-support actions by Policy goal |
| Measurement | CD.1.1. Number of projects and percentile share (%)  
CD.1.2. Cost (10^6 €) |
| Sources | CORDA platform |
| Remarks | CD.1.1 The number of projects per Project Cluster (result of PC.1.1) will be further categorised per Type of Action  
CD.1.2 The total cost of projects per Project Cluster (result of PC.1.2) will be further categorised per Type of Action |
<table>
<thead>
<tr>
<th>Code</th>
<th>CD.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Distribution of partners per Type of Organisation</td>
</tr>
<tr>
<td>Definition</td>
<td>The share in project partnership of large enterprises, SMEs, research organisations, higher and secondary education, public bodies and other per H2020 equivalent Type of Action, i.e. I.A. = L2, R.I.A. = L0 &amp; L1 and CSA</td>
</tr>
<tr>
<td>Scope</td>
<td>It describes the participation of the types of private and public sector to transport R&amp;I projects</td>
</tr>
<tr>
<td>Measurement</td>
<td>Number of partners and percentile share (%)</td>
</tr>
<tr>
<td>Sources</td>
<td>CORDA platform</td>
</tr>
<tr>
<td>Remarks</td>
<td>The average number of partners differentiates by Type of Action while the differentiations within the same Type of Action are relatively small.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>CD.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Share of INCO projects</td>
</tr>
<tr>
<td>Definition</td>
<td>The share of projects involving (flagged) international cooperation</td>
</tr>
<tr>
<td>Scope</td>
<td>It shows the role of international cooperation for achieving the specific Policy goal.</td>
</tr>
<tr>
<td>Measurement</td>
<td>Percentile share (%)</td>
</tr>
<tr>
<td>Sources</td>
<td>CORDA platform</td>
</tr>
<tr>
<td>Remarks</td>
<td>Different definitions of international cooperation between different framework programmes should be taken into consideration</td>
</tr>
</tbody>
</table>

**Indicator sub-group: CA. Policy goal Analysis - Cluster Achievements**

<table>
<thead>
<tr>
<th>Code</th>
<th>CA.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Number of peer-review publications</td>
</tr>
<tr>
<td>Definition</td>
<td>Total and average number of peer-review publications, i.e. scientific journals and international conferences</td>
</tr>
<tr>
<td>Scope</td>
<td>It is one of the features that indicates the scientific contribution and the dissemination of research.</td>
</tr>
<tr>
<td>Measurement</td>
<td>Number</td>
</tr>
<tr>
<td>Sources</td>
<td>CORDIS, TRIP, Google Scholar, Scope, Web of Science, OpenAIRE</td>
</tr>
<tr>
<td>Remarks</td>
<td>The results are biased at the level of reliability of the above private sources and the short time since the conclusion of projects.</td>
</tr>
<tr>
<td></td>
<td>It should be analysed as an achievement in combination to indicator C.A.2</td>
</tr>
<tr>
<td></td>
<td>Corresponds to H2020 KPI</td>
</tr>
<tr>
<td>Code</td>
<td>CA.2</td>
</tr>
<tr>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Name</td>
<td>Number of citations</td>
</tr>
<tr>
<td>Definition</td>
<td>Total and average number of citations so far per peer-review publication</td>
</tr>
<tr>
<td>Scope</td>
<td>It is one of the features that indicates the scientific contribution and the dissemination of research</td>
</tr>
<tr>
<td>Measurement</td>
<td>Number</td>
</tr>
<tr>
<td>Sources</td>
<td>Google Scholar, Web of Science, Scopus</td>
</tr>
<tr>
<td>Remarks</td>
<td>The citations include self-reference. The results are biased to the degree of reliability of private sources. The number of citations is changing through time as the publications gain readership. The indicator should be analysed as an achievement in combination to indicator C.A.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>CA.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Number of patent awards and/or applications</td>
</tr>
<tr>
<td>Definition</td>
<td>Total number of patent awards and/or applications by Project Cluster</td>
</tr>
<tr>
<td>Scope</td>
<td>It is one of the features that indicates the scientific contribution and the dissemination of research</td>
</tr>
<tr>
<td>Measurement</td>
<td>Number</td>
</tr>
<tr>
<td>Sources</td>
<td>CORDA platform</td>
</tr>
<tr>
<td>Remarks</td>
<td>Corresponds to H2020 KPI</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>CA.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Number of projects involving pilot and demonstration activities</td>
</tr>
<tr>
<td>Definition</td>
<td>Total number of projects involving pilot and demonstration activities</td>
</tr>
<tr>
<td>Scope</td>
<td>It is one of the features that indicates the scientific contribution</td>
</tr>
<tr>
<td>Measurement</td>
<td>Number</td>
</tr>
<tr>
<td>Sources</td>
<td>CORDIS Platform (Summary of projects’ final report)</td>
</tr>
<tr>
<td>Remarks</td>
<td>The value varies per Type of Action as IA and most of RIA projects involve demonstration and testing a lot more often than CSA projects</td>
</tr>
<tr>
<td>Code</td>
<td>CA.5</td>
</tr>
<tr>
<td>--------</td>
<td>-------</td>
</tr>
<tr>
<td>Name</td>
<td>Share of projects developing innovative products, services, processes and methods for commercial or other use</td>
</tr>
</tbody>
</table>
| Definition Scope | CA.5.1 The share of projects which led to new innovative products, services, processes and/or methods  
CA.5.2 The share of the aforementioned products, services, processes and methods for commercial use |
| Measurement | It shows the contribution of the projects to the development of innovative products, services, processes and methods with focus on their potential impact on the market |
| Sources | Number |
| Remarks | Questionnaire survey to the Project Coordinators |
| Code   | The results depend on the feedback by Project Coordinators.  
The value varies per Type of Action as IA and most of RIA projects involve products a lot more often than CSA projects  
Corresponds to H2020 KPI |

<table>
<thead>
<tr>
<th>Code</th>
<th>CA.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Number of recruited persons working throughout a project’s duration still working or have worked again for a project partner</td>
</tr>
<tr>
<td>Definition</td>
<td>Number of persons recruited for the first time in order to cover the project needs, who are still working or have worked again for a project partner after the conclusion of the project</td>
</tr>
<tr>
<td>Scope</td>
<td>It shows the contribution of the projects to a sustainable job environment</td>
</tr>
<tr>
<td>Measurement</td>
<td>Number</td>
</tr>
<tr>
<td>Sources</td>
<td>Questionnaire survey to the Project Coordinators</td>
</tr>
</tbody>
</table>
| Remarks | The results depend on the feedback by Project Coordinators.  
Corresponds to H2020 KPI |

<table>
<thead>
<tr>
<th>Code</th>
<th>CA.7</th>
</tr>
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<tbody>
<tr>
<td>Name</td>
<td>Share of projects which established cooperations throughout a project’s duration</td>
</tr>
<tr>
<td>Definition</td>
<td>Share of projects which within their duration led to the establishment of a cooperation between participants (partners, stakeholders, end-users etc.) for the first time and then this cooperation was used for other purposes beyond the projects’ objectives</td>
</tr>
<tr>
<td>Scope</td>
<td>It shows the contribution of the projects to the establishment of cooperation schemes with added value for the participants</td>
</tr>
<tr>
<td>Measurement</td>
<td>Number</td>
</tr>
<tr>
<td>Sources</td>
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</table>
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