

How does European transport research and innovation contribute to the digital transformation of Europe?

Headlines

- Advances in fields linked to the digital transformation, including Artificial Intelligence (AI), big data, telecommunications, connectivity and sensor technology are disrupting the transport sector.
- Research and innovation (R&I) in digital technologies for transport is crucial to make Europe fit for the digital age.
- R&I has been intensified both in terms of funding from EU Research Framework Programmes, number of projects and actors involved. It is expected that when more technologies become mature, more funds will be granted to validation and demonstration projects, which will further support the digital transformation of transport and mobility.

Introduction

Transport is one of the main sectors of the European economy, having also a direct impact on the environment, safety and the overall quality of life. The advent of Connected and Automated Transport (CAT) will likely provide a breaking point in mobility. Advances in the field of Artificial Intelligence (AI), on which autonomous road vehicles heavily rely, are developing steadily at present and are equally expected to bring extensive changes to mobility and transport systems. The impacts of such a revolution on transport have the potential to be far-reaching, from reducing road accidents to allowing more efficient traffic flows and decreasing road transport emissions if the transition happens in a coordinated way¹. Along with the development of these technologies, a paradigm change in mobility is already on the way. Traditional private car ownership is challenged by Mobility as a Service (MaaS) or Transport as a Service (TaaS), which represent a shift away from personally owned means of transport towards on demand pay-per-use mobility solutions,

including micro-mobility. Digital technologies can also influence real-time transport demand, by optimising travel and use of alternative routes, through intelligent applications and user information services. Digitalisation and automation, together with electrification are heavily impacting vehicle design and manufacturing, as well as employment in the automotive industry and related economic sectors. New technologies in the digital age provide a series of opportunities for a positive transformation of the transport sector. Nevertheless, there are numerous technological and societal challenges that require attention. Potential challenges such as data collection, linked also to privacy and cybersecurity also need to be addressed with research and innovation (R&I) actions. Targeted R&I facilitates regulatory policies and technological advancement towards addressing current socio-economic challenges in Europe. R&I in digital technologies for transport is also crucial to meet EU targets, as outlined in the Political Guidelines of the European Commission 2019-24² and is crucial to make Europe fit for the digital age³.

In this context, the European Commission adopted in 2017 the Strategic Transport Research and Innovation Agenda (STRIA) as part of the "Europe on the move" package, highlighting main transport R&I areas and priorities for clean, connected and competitive mobility. The European Commission's Joint Research Centre (JRC) has developed the Transport Research and Innovation Monitoring and Information System (TRIMIS), in order to provide an assessment of technology trends, R&I capacities, to publish information, data, and to develop analytical tools on the European transport system. One of the sub-tasks of TRIMIS is the creation of an inventory and the regular reporting on new transport technologies. A cornerstone of this process is the establishment of an assessment methodology, based on the taxonomic clustering of transport technologies and the use of appropriate indicators. The analyses in this brief focus on three STRIA research areas: Connected and automated transport (CAT), Smart mobility and services (SMO) and Network and traffic management systems (NTM), which are expected to have the most relevance and impact on Digital Transformation in the transport sector. As shown in Figure 1, these three areas combined receive considerably more

¹ Alonso Raposo, M. (Ed.) et al. 2019, The future of road transport - Implications of automated, connected, low-carbon and shared mobility, EUR 29748 EN, Publications Office of the European Union, Luxembourg, doi: 10.2760/9247.

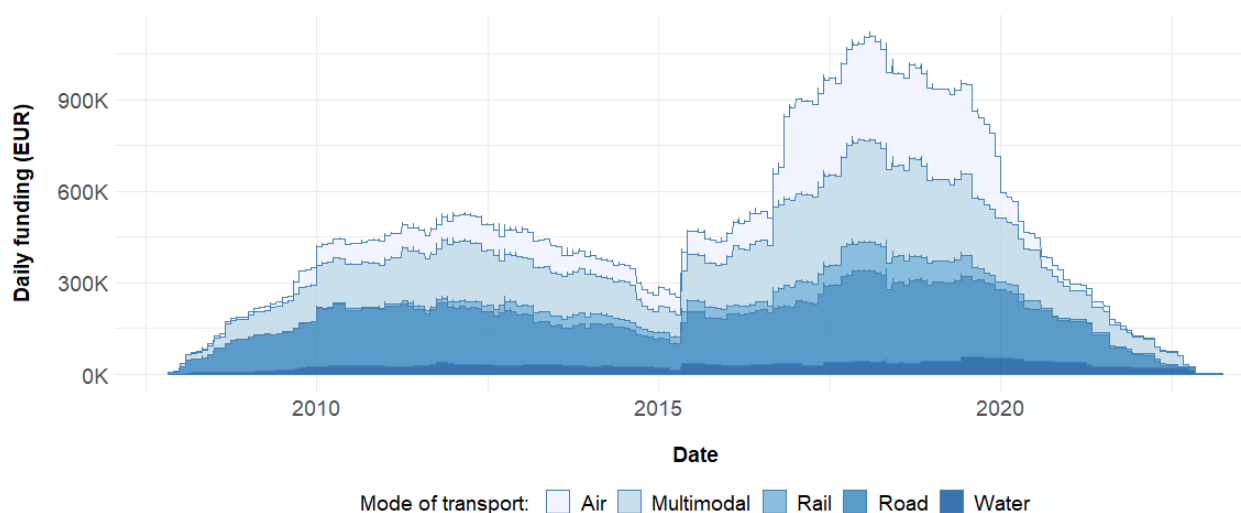
² https://ec.europa.eu/commission/sites/beta-political/files/political-guidelines-next-commission_en.pdf

³ https://ec.europa.eu/info/priorities/europe-fit-digital-age_en

funding over time, particularly for research on multimodal and air transport. The numbers are expected to be even higher as there are still Horizon 2020 (H2020) calls upcoming.

This brief dives deeper into these funding numbers and focuses on the technologies that are influencing the path towards a digital age in transport, focusing on the technology maturity from European research and innovation framework programmes, using the methodology developed for TRIMIS.

Figure 1. Daily funding of digital transportation research by mode under FP7 and H2020



The figure assumes that granted funds are spread equally throughout the project's lifetime and is based on projects granted until Summer 2019

Digital transport technologies in European research

The analysis draws on the TRIMIS database, which collects information on publicly funded transport research and innovation projects across Europe. Currently the database contains over 6,700 projects that started between 2000 and 2019. For this brief, only EU 7th Framework Programme (FP7) and H2020 projects have been included in the analysis.

Methodology

The analysis currently focuses on technologies researched in European Framework Programmes, specifically projects from FP7 and H2020, with a total of 2,242 projects falling within the scope. A total of 797 technologies were identified, also showing that many European funded projects do not focus solely on technology development. 96 of the identified technologies are linked to the NTM roadmap, 72 are linked to the CAT roadmap, and 33 to the SMO roadmap.

The creation of the technology and technology theme taxonomy enables different visual representations. Figure 2 focuses on the top 7 technologies for the three STRIA roadmaps relevant to the digital transformation: Network and traffic management systems (NTM, in blue), Smart mobility and services (SMO, in green) and Cooperative, connected and automated transport (CAT, in red).

Two metrics are shown, that highlight the combined effort that has been put into the technology:

- total value of all projects that have researched the technology (i.e. the total investment, by both the EU and industry, in the development of the technology);
- number of projects that have researched the technology.

In addition, the maturity was assessed for all technologies researched within the projects. The assessment is based on technology readiness levels (TRLs), estimating technology maturity at the initial phase of a programme (see Annex G of the H2020 2014-2015 Work Programme). TRLs are based on a scale from 1 to 9, with 9 being the most mature technology.

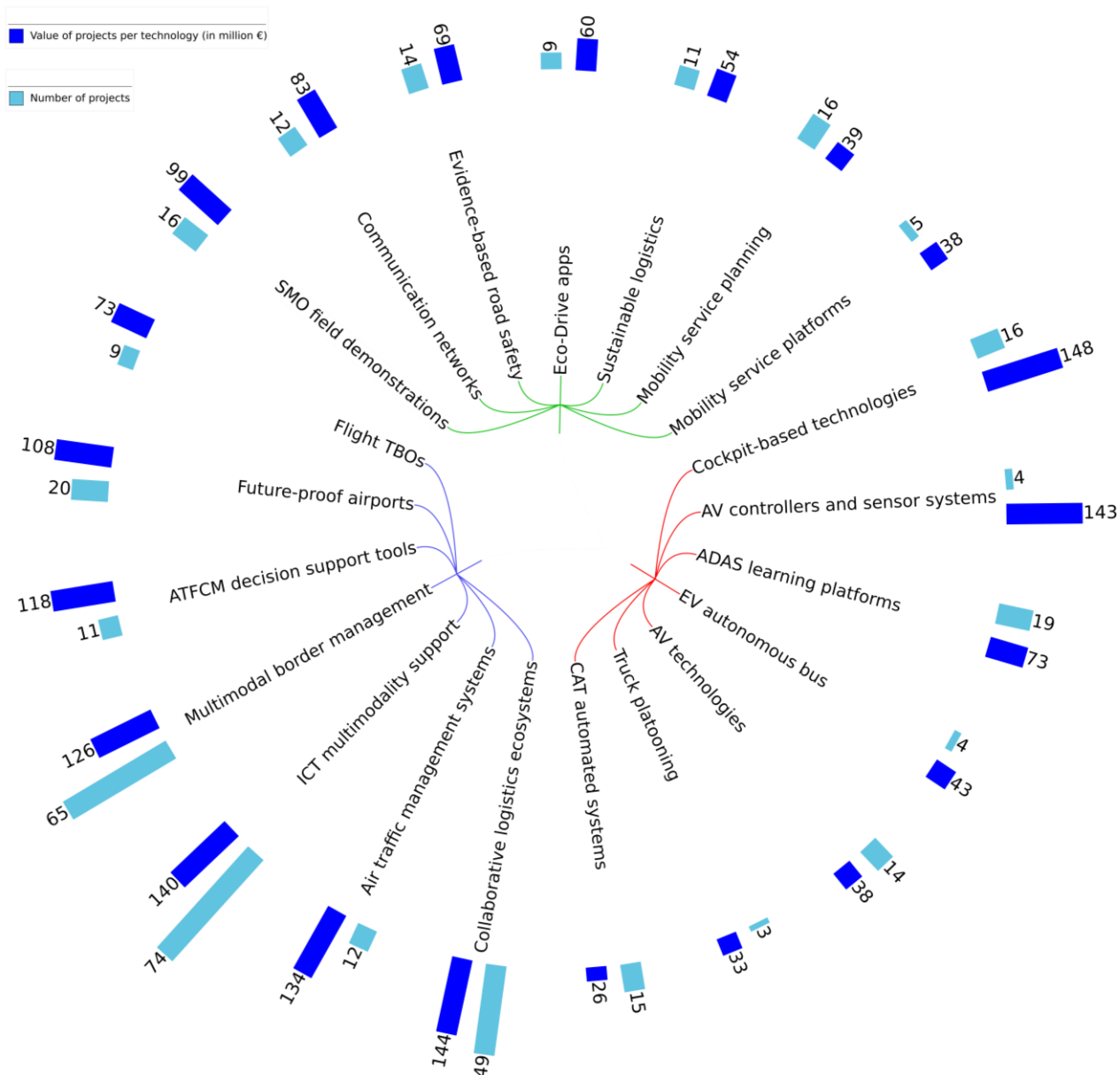
As shown in Figure 3, in TRIMIS, the nine TRLs have been consolidated into four development phases: research, validation, demonstration (incl. prototyping/pilot production) and implementation. These are used to monitor and describe the maturing of each technology in a similar way to the original TRLs. A development phase is assigned to each project-technology combination, by scanning the project for explicit references or based on expert judgement.

Results

Figure 4 shows initial results for the top 3 technologies in terms of budget allocated, for the NTM (area delimited in blue), CAT (area delimited in red) and SMO (area delimited in green) STRIA roadmaps.⁴ Even though the roadmaps' technology clusters are not comparable amongst them, most technologies have been researched in FPs at low development phase levels. This is more evident for two of three dominant technologies in terms of budget in the NTM roadmap ("collaborative logistics ecosystem" and "ICT multimodality support"). On the contrary, the "AV controllers and sensor systems" technology in the SMO roadmap, researched only in four very large-scale projects, has reached a higher maturity.

⁴ Source: Tsakalidis, A., Gkoumas, K. and Pekar, F. Digital transformation in transport: Policy perspectives and technology developments in Europe. TRA 2020, Helsinki, 27-30 April 2020

Figure 2: Top 7 technologies linked to the STRIA roadmaps: NTM (blue colour), SMO (green colour) and CAT (red colour)



Abbreviations - ADAS: Advanced driver assistance systems; CAT: Connected and automated transport; AV: Autonomous Vehicle; EV: Electric Vehicle; TBO: Trajectory Based Operation; ATFCM: Air Traffic Flow and Capacity Management; ICT: Information and communications technology.

Figure 3: TRLs and development phases in TRIMIS

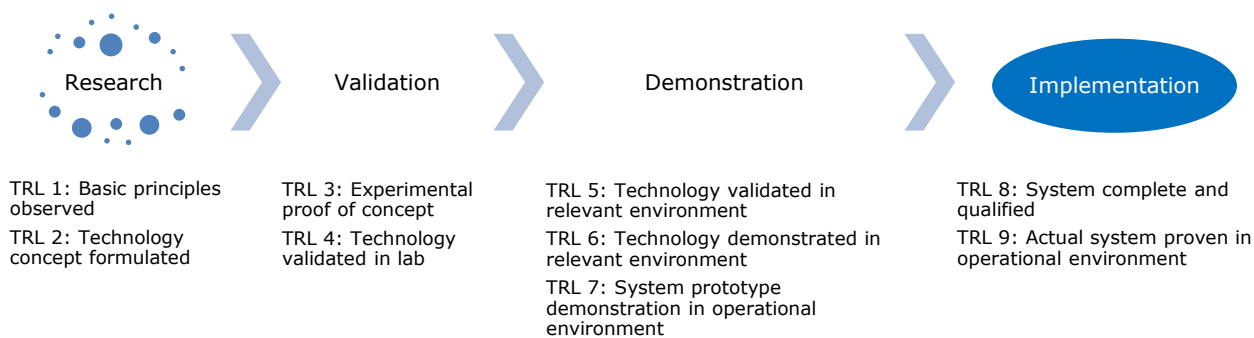
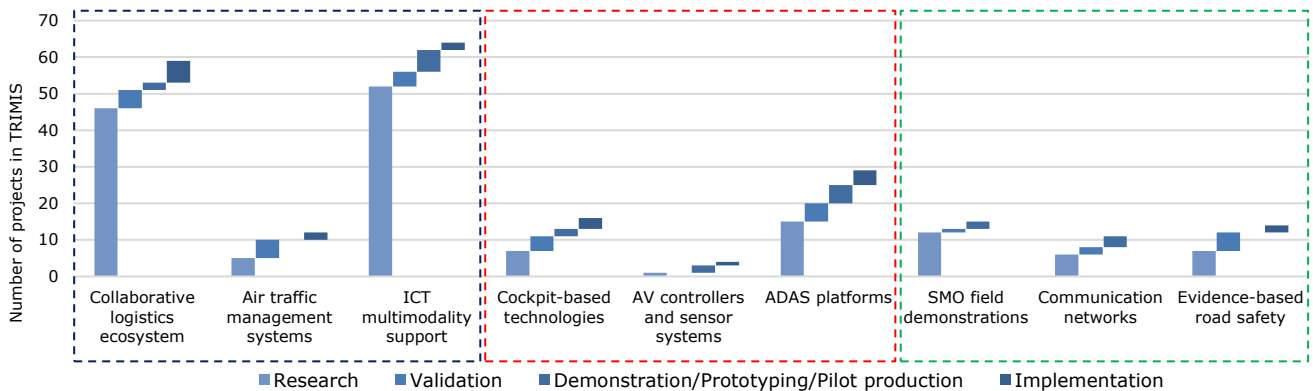


Figure 4: Technology development phases for the top-3 technologies in terms of budget in the three STRIA roadmaps



Conclusions

The digital transformation of the transport sector is ongoing. TRIMIS provides a database of European transport related R&I projects and programmes and specific technology assessment methodologies, that can be used as a basis for monitoring innovation capacities, as well as to support the assessment of the European transport sector performance and technological maturity status. This policy brief provides a first look on a comprehensive assessment of technologies relevant to the digital transformation, based on the TRIMIS database.⁵

By linking technology metrics with organisational data, technology value chains can be identified and assessed. This information can contribute to the optimisation of funding allocation in EU programmes and the development of targeted measures (i.e. policy initiatives), to promote transport innovation. Furthermore, analysing the development phase of technologies researched within Framework Programmes, it is possible to have an overview of technologies that are close to market (technologies with high maturity), or those that need further development.

⁵ This document is based on three JRC Science for Policy reports on Network and traffic management systems (NTM), Connected and automated transport (CAT) and Smart mobility and services (SMO), and was developed by the respective leading authors.

van Balen, M., Gkoumas, K., Grosso, M., Tsakalidis, A., Ortega Hortelano, A., Haq, G., and Pekár, F., Research and innovation in network and traffic management systems in Europe: An assessment based on the Transport Research and Innovation Monitoring and Information System (TRIMIS), Publications Office of the European Union, Luxembourg, 2020

Gkoumas, K., van Balen, M., Grosso, M., Marques Dos Santos, F.L., Tsakalidis, A., Ortega Hortelano, A., Haq, G., Pekár, F. Research and innovation on connected and automated transport - An assessment based on the Transport Research and Innovation Monitoring and Information System (TRIMIS), EUR 30009 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-76-14122-8, doi:10.2760/353623, JRC118270

Tsakalidis, A., van Balen, M., Gkoumas, K., Haq, G., Ortega Hortelano, A., Grosso, M., and Pekar, F., Research and innovation in smart mobility and services in Europe: An assessment based on the Transport Research and Innovation Monitoring and Information System (TRIMIS), Publications Office of the European Union, Luxembourg, 2020

Regarding technologies that may have an impact on the digital transformation, the analysis leads to the following conclusions:

- There are several large-scale demonstration and implementation projects that focus on technologies researched, also in a more mature phase. This is the case of “air traffic management” in the NTM (under the SESAR Joint Undertaking) and “AV controllers and sensors systems” in the CAT roadmap.
- A number of technologies are addressed also under the Small Medium Enterprise (SME) instrument scheme. This is especially evident within “collaborative logistic ecosystems” in the NTM roadmap, and it is an indication that this theme attracts innovators who identify research and market gaps that need to be addressed, or who can come up with possible disruptive ideas that can further contribute to innovation.

The main technological areas identified above support the digital transformation of various elements of the transport sector, with a potential impact on the economy, the environment and quality of life. The identified technologies cover a broad spectrum of development phases and include both more innovative technologies researched towards their market potential, as well as large-scale demonstration and validation of mature technologies. It is expected that when more technologies become mature, more funds will be granted to demonstration and validation projects, which will further support the digital transformation of transport and mobility, in order to meet the objectives of the EU fit for the digital age ambition.

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The views expressed here are purely those of the authors and may not, under any circumstances, be regarded as an official position of the European Commission. The European Commission’s Joint Research Centre (JRC) is in charge of the development of the Transport Research and Innovation Monitoring and Information System (TRIMIS), under the supervision of the European Commission’s Directorate-General for Mobility and Transport (DG MOVE) and Directorate-General for Research and Innovation (DG RTD) which are co-leading the Strategic Transport Research and Innovation Agenda (STRIA).