



TRANSPORT CHALLENGE IN 2020 – 2050

ECTRI POSITION PAPER

Challenges and Research Needs for Mobility 2020-2050 Efficient, multimodal, inclusive, safe mobility in Europe

November 2019

The European Conference of Transport Research Institutes (ECTRI) is an international non-profit association that was officially founded in April 2003. It is the first attempt to unite the forces of the foremost multimodal transport research centres across Europe and to thereby promote the excellence of European transport research.

Today, it includes 28 major transport research institutes or universities from 21 European countries. Together, they account for more than 4,000 European scientific and research staff in the field of transport. ECTRI as the leading European research association for sustainable and multimodal mobility is committed to provide the scientifically based competence, knowledge and advice to move towards a green, safe, efficient, and inclusive transport for people and goods.

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1. Introduction

ECTRI launched its Thematic Groups in September 2007 as a means to facilitate exchanges among its researchers interested in similar research fields and in order to promote joint initiatives and positions. The main objectives of these groups are to define research challenges of interest for supporting EC policies and programmes, to increase successful participation in EU projects and to provide a platform for networking and scientific exchanges.

One of these groups is the ECTRI'S Thematic Group Mobility (TG Mobility) which has been established in 2012. The group is comprised of 46 scientists coming from 27 ECTRI member institutes, whose research interests and activities span over several transport research disciplines and over all modes of transport (see annex I for members list). In its current term 2018-2020, TG Mobility is led by Dr. Evangelos Mitsakis (Moderator, Senior Researcher at CERTH-HIT), Dr. Alexandra Millonig (Rapporteur, Senior Scientist at AIT), Ms. Leire Serano (Rapporteur, Project Manager at DEUSTO) and Dr. Allain L'Hostis (Rapporteur, Researcher at IFSTTAR).

The group aims to contribute to the transport research domain in Europe and globally, by actively engaging in research activities of common interest, by exchanging related information, promoting events of interest and the exchange of scientific personnel.

2. Focus Areas

The present document aims to provide an overview of key research ideas and topics from the members of TG Mobility, which the group members believe will be of importance for the research of the next decade, with potential impact of more than 30 years. The topics (research needs) included herein have been developed within the group, under the coordination of the moderator and the support of the rapporteurs.

The position paper of TG Mobility includes an assessment of the challenges for mobility in Europe for the period 2020-2050, followed by a description of research needs for the following five areas of interest for TG Mobility:

- Travel Behavior
- Multimodal mobility, Mobility management, Shared mobility and Mobility as a Service
- Land use and transport interaction
- Connected and Automated mobility
- Cross-thematic research needs

3. Challenges for mobility in Europe 2020-2050

Understanding current and future mobility challenges and trends is a key element, in order to shape transport policies and orientate future transport and mobility research. The transport and mobility domains are predominantly impacted by societal, economic and political influences. Mobility in Europe has been significantly associated with motorized transport, although

sustainable transport modes are gaining increasing acceptance by travelers as well as market share. Multimodal transport has been promoted and to some extent the objectives have been met. Planning for sustainable mobility has also gained importance and acknowledgement by relevant authorities, resulting to efforts being placed, such as the Sustainable Mobility Plans, towards inclusive and sustainable transport systems, that increase accessibility.

Furthermore, Europe places efforts towards the achievement of autonomy of mobility systems, both for public transport modes as well as for private and shared vehicles. These efforts are largely affected by and compared with similar developments in other countries (mostly USA). Automated vehicles are expected to be mostly used as shared vehicle fleets, in the form of taxis, shared ride services or new mobility services that already appear on a frequent basis. The role of the private sector in bringing new innovation is expected to be major.

The main challenges and trends that will shape future transport policies as well as future transport and mobility research in Europe are presented in the following table¹.

Challenge/ Trend category	Challenge/Trend description
Economy	Changing EU economy position vis-a-vis global economy developments
	Changing labor force skills and characteristics
Society	Ageing society
	Increasing life expectancy
	Increased/More frequent long-distance intra-EU and extra-EU mobility needs
	Need for increased societal inclusiveness
	Decreased ownership - Increased usership
Environment	Strict environmental regulations on all transport modes
	Need for increased energy efficiency
	Climate change and extreme weather events' impacts
Technology & Digitalization	Increasing use of digital media (incl. social networking media and e-services)
	Increased digital "footprints" of all human and economic activities
	Digital mobility
	Autonomy and automation of multimodal transport and mobility systems
	Internet of Things, Internet of Mobility
	Smart cities and smart regions
New business models	From ownership of vehicles to usership of shared vehicle fleets
	Co-development of new mobility solutions by multiple stakeholders
Other	Industrial competition from extra-EU countries
	Cybersecurity

The above form a framework for future research activities related to transport and mobility in Europe, specific aspects of which are presented in the subsequent sections of the position paper.

1 *Partially adapted contents from the H2020 project Mobilty4EU*

3.1. Research needs for Travel Behavior (incl. traveler and driver)

Travel behavior is a research domain of particular interest that has been extensively studied by several researchers in Europe and internationally. As new mobility services and modes of personalized transport are expected to prevail, associated with major advances in related technologies, there is a changing landscape of mobility, as well as challenges and influencing factors as described previously. Therefore, there is a growing need as well as growing interest for deeper analysis of several aspects related to travel behavior research, as mentioned next.

Research Need TB1: Novel (big data) technologies overcoming traditional burdens in travel behavior analyses.

There is a need for detailed data collection of a greater number of travelers. Although this is in general positive, there are challenges that need to be tackled, such as a) Privacy issues, b) Availability of data by commercial companies, vs data collected for research purposes, c) e-literacy implications and how to deal with them.

Research Need TB2: Improve prediction quality of behavioral models

The development of models improved travel behavior modelling. Still, the estimation of impacts of mobility measures is quite unreliable. Therefore it is needed to assess: a) the need for more evaluation (and evaluation data) of measures to be able to learn from, b) structured evaluations of the prediction capability of behavioral models and their impact estimations accordingly, c) the need for creating best practice collections based on data/facts, d) the need for creating 'failed practice' collections.

Research Need TB3: Cope with the dynamics of technical/technology developments, including business and services issues, and emerging trends (eg. CCAD, e-Scooter, UBER, MaaS, urbanization, migration)

There is a need to support research on issues related to uncertainty of related impact assessment, as well as methods, tools and models able to handle these uncertainties.

Research Need TB4: Special mobility groups

There is a need to develop new models and tools, that will be able to account for specificities of special traveler groups, such as a) tourism related mobility, b) business related travel, c) eco-friendly and affordable mobility for rural areas.

3.2. Research needs for Multimodal mobility, Mobility management, Shared mobility and Mobility as a Service

Multimodality refers to the possibility of using different concurrent transport options and means for the same trip. The geography of Europe has become dominantly marked by urban space. As the share of European citizens living in urban areas is expected to grow from 73% in 2014 to 84% by 2050, travel is taking place increasingly in urban contexts. The current urban mobility system is considered unsustainable, because of its strong dependence on private cars. To this

issue, the 2011 White Paper from the European Commission fixed objectives for the reduction of emissions from transport.

Research Need MM1: Alternatives to private-car based mobility: plethora of supply options

In a context where a single transport mode is dominant and unsustainable, the search for a disruptive technology (e.g. electrification, vehicle autonomy, or else) that, alone, could simply replace the current automobile system, seems uncertain. In order to mitigate the risks of such an uncertainty, and in parallel to these efforts, it seems relevant to support research activities to existing or future alternatives to the private car-based mobility. In addition, the principle of choice for users means efforts should be pursued in direction of reducing dependency to the car with a single occupant.

Research Need MM2: Shared mobility services

There is a need to evaluate the options, including traveller preferences and acceptability concerning current and future options for shared mobility. The growing tendencies towards reduced ownership of vehicles leads to an increasing demand for shared mobility. Research is needed concerning modelling, transport policies and business developments that will shape the shared mobility domain in the next decades. Furthermore, there is a need to assess new emerging transport modes, including micro-mobility and other personalized mobility services that will emerge in the next years.

Research Need MM3: Mobility as a Service

There is a need to understand the influencing factors that may (or may not) result to integrated mobility services, such as those that shape the concept of Mobility as a Service (MaaS). Which trips, which travel categories, under which conditions will be impacted? How? What is the role of current and future modes of transport? How will cities adopt to the changes brought by MaaS in terms of daily transport operations as well as of transportation and sustainable urban mobility planning?

Research Need MM4: Multi-thread Resilient transport systems

There is a need to investigate all topics related to multi-thread resilient transport systems in Europe, from the perspectives of threads such as a) cybersecurity, b) infrastructure security, c) resilience against unplanned climate change and extreme weather events' related risks and threads.

3.3. Research needs for land use and transport interaction

The major argument for considering the topic land-use interaction comes from the observation of the vicious circle linking the development of the car transport system and the urban sprawl. Is it possible to develop and support alternatives to this unsustainable type of city/transport development?

This interrogation has led notably to the introduction of the Transit Oriented Development model, and to all the related researches on identifying case studies, understanding the dynamics and providing indications for actual transport and city development.

Research Need LUT1: Collection of case studies

Much still has to be done in this field since European experiences are not enough accounted for, under the prism of TOD, in the scientific literature despite successful and insightful cases (e.g. south Randstad NL). Documenting these cases with research could provide relevant insights for future urban sustainable development in Europe.

Research Need LUT2: Land use and transport planning towards increased liveable spaces

There is a need to investigate the possibilities of creating liveable spaces and areas, which are currently “occupied” by the needs of private motorized traffic, both in urban and peri-urban environments. The new mobility solutions may allow for an improved management of demand, which itself may result to spaces/areas becoming available for other uses, and not only for traffic/transport purposes.

3.4. Research needs for Connected, Cooperative and Automated mobility

Connected, cooperative and automated mobility (CCAM) is a wide area of multiple technologies that promise a number of benefits for the individual, the society and the economy in the various fields of transportation:

- In road transport, it can provide increased levels of safety and efficiency, as well as better social penetration and acceptance for users
- In railway transport, it enhances the performance of the overall transport network, including train operations, management, maintenance
- In waterborne transport, it can improve safer shipping and efficient logistics, as well as benefits for the environment
- In aviation, higher levels of automation are aimed, overpassing those obtained by the extended autopilot. In the other hand, the proliferation of applications relying in drones, open new applications which must be considered.

Research Need CCAM1: Industrial and technological competitiveness

In general, CCAM can support the competitiveness of the European transport manufacturing, telecom and IT industries on worldwide markets, and enable disruptive innovation, which will lead to new services concerning the transportation of both people and freight, allowing the sharing of information in a fast, cooperative, secure and reliable way.

Research Need CCAM2: Improved and accurate modeling of CCAM systems

Although improved considerably over the last 10 to 20 years, the current approach to the deployment of technologies related to CCAM is too coarse. Often, models lack a human perspective, which leads to difficult adoption of the technologies by the wide public. Transparent usability of the applications related with CCAM is needed, in order to obtain a broader adoption by society, including cooperative mobility services (carsharing, carpooling, or collaborative logistics, among others...), as well as applications oriented to the multimodal mobility, such as initiatives for mobility as a service.

Research Need CCAM3: Safety aspects of CCAM systems

Connected and automated mobility implies a number of essential paradigm shifts in road transport, e.g. where safety and efficiency have been organized for long time with the driver and other road users in charge of complying with traffic rules and traffic management, connected and automated road transport turns this concept to be responsibility of the electronic control systems embedded in the vehicle, which take decisions instead of the human driver. The perception and cognitive capabilities of an automated vehicle are determined by the performance of its perception systems, as well as the implemented algorithms and the communication systems with the infrastructure and elements in the road. In other transport modes, this paradigm offers the possibility to significantly reduce risks, to improve efficiency and to enhance the management of emergencies.

Research Need CCAM4: Societal aspects of CCAM

Innovation towards connected and automated mobility poses a multitude of challenges: generally for all modes, these include the development of technologies at hardware and software levels, communication technologies for the vehicle and infrastructure, as well as decision-making by means of artificial intelligence. At the same time, the needs and expectations of the society have to be considered, particularly in terms of safety and data security, and need to be translated into technical and legal requirements.

Research Need CCAM5: Opportunities and threads of 3D mobility

Air mobility (also called frequently 3D-mobility, as vehicles are now able to travel also on the vertical axis) is expected to significantly alter the mobility landscape, especially in urban areas. Research concerning the safe and efficient use of drones is needed, that will result to methods, models, tools, technologies and operational systems to enable the deployment of drones for a variety of purposes (from parcel services to passenger transport). Acceptance by the society should also be studied.

3.5. Cross-thematic research needs

As mentioned in the introductory sections of the present position paper of TG Mobility, the domains of transport and mobility are interrelated with each other, as well as with other developments in the society, the economy and the technology domain. It is therefore important to support research that is cross-thematic and multi-disciplinary, so as to be able to assess and tackle the associated challenges.

Research Need CTR1: Impacts of Artificial Intelligence and Quantum Computing

Research shall cover impacts of Machine Learning, Deep learning as well as other types of Artificial Intelligence, which itself is a rapidly evolving domain. The impacts of AI on transport and mobility, as well as on the society in general, cannot be easily assessed today. However, indicative areas where AI may have significant impacts include: a) advanced tools for transportation modelling and forecasting, b) travel pattern recognition, c) sophisticated automated/autonomous mobility systems and d) enhanced personalization of mobility services.

Furthermore, research is needed on the possible exploitation of the major advances in computational capabilities offered by current and future quantum computing technologies.

Research Need CTR2: Applied multimodal traffic management for passenger and freight transport

Current efforts in the network traffic management domain focus on models and tools, which rely on few or no real-world evidence and data. There is a need for real-world developments of novel systems, methods, technologies for multimodal network traffic management, accounting for a variety of prevailing developments (behavioral, societal, technology etc).

4. Annex I - TG Mobility members (as of November 2019)

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