EARPA Position Paper
Future Mobility for People and Goods
06 July 2020

ABOUT EARPA

Founded in 2002, EARPA is the association of automotive R&D organizations. It brings together the most prominent independent R&D providers in the automotive sector throughout Europe. At present its membership numbers 49, ranging from large and small commercial organizations to national institutes and universities.

SCOPE OF THIS DOCUMENT

The EARPA Foresight Group *Future Mobility for People and Goods* deals with the overall aspects, such as implementation and business models of the mobility of people and goods in our future society, based on the technological developments in other EARPA groups. This group aims at anticipating the forthcoming research needs that cannot be addressed by industry or academia alone but that need support from future research and innovation framework programmes.

INTRODUCTION AND CONTEXT

Life in Europe is in a period of change, fuelled by several coinciding trends, which will have a strong impact on future mobility for people and goods.

More than 80% of European population was equipped with cell phones in 2019[1]. Next generation technologies such as IoT and 5G, which are expected to show a rapid uptake in the coming years, will drive deployment of innovations in the transport sector as well as the development and deployment of new services. From a people perspective, we see that, while the 20th century was the century accessibility was created for all, by offering transport services, in the first half of 21st century this focus is expected to shift towards offering targeted mobility services.

New use cases for electric vehicles are emerging for passenger vehicles, light commercial vehicles and medium to large trucks. Alternative propulsion system vehicles are nearing an inflection point as a result of a variety of developments such as, changing consumer attitudes, growing availability of charging infrastructure and stricter regulatory policies.

The upcoming solutions for mobility of people and goods may change the positioning of the different modes and services, and the roles and relevance of the different stakeholders involved.

In addition, also 'black swan' events occasionally occur (such as the current COVID-19 crises) disrupting customer and business priorities and their modal choice.

New mobility innovations will provide solutions to the major societal challenges and aim to contribute to increased welfare of EU citizens and competitiveness for EU companies, and at the same time they will lead to new challenges to be anticipated and mitigated. This document highlights the drivers and research needs as identified by the EARPA experts.

[1] https://www.gsma.com/mobileeconomy/europe

Multiple drivers are reshaping the mobility landscape.

- *Social drivers* include demographic and behavioural changes, such as increasing migration between rural and urban areas, aging of population and shifting user preferences, including importance of sustainable options.
- *Market drivers* include the rise of the sharing economy & MaaS, e-commerce, (global) service platforms, prosumerism and green consumerism adding new roles in the service chain.
- *Regulatory drivers* include environmental and health targets/policies, stricter global standardization, as well as a drive towards zero fatalities and severe injuries from transport accidents.
- *Technology drivers* include electrification, digitalization and automation and a strong increase of service business in all aspects of life.
- *'Black Swan' drivers* include major disruptive events or incidents that are difficult or impossible to foresee, but requiring rapid interventions and adaptation; resilience is key in these circumstances and for some cases contingency plans can be prepared to limit the negative impacts (for instance COVID-19 outbreak, volcano eruptions, low water levels in rivers, and collapse of infrastructure at critical location).

These drivers combined lead to major temporal and/or structural transformations of mobility for both people and goods, requiring new skills and assets of different actors. The two most important transformations for the mobility of people and goods are the **digital** and **energy** transformations.

1) Digital Transformation

Where the digital transformation may significantly improve quality of life of an individual user and the society on a higher level, it is also important to be aware of potential negative aspects and challenges. This could be in terms of international competitiveness but also when it comes to limitations for individuals to really access and benefit from digital solutions. At the same time, the non-systemic approach to this phenomenon may place foreseeable changes off the radar, such as changes in the labour market, economic organisation and societal perceptions leading to changes in mobility demand and user requirements. This may lead to unforeseen '**systemic**' disadvantages of the transport system and its environment. Such systemic impacts should be orchestrated with care to ensure the mobility & transportation R&I investments on a system level contribute optimally to EU welfare.

The impact of the digital transformation on the mobility system needs to be assessed in a systemic perspective defined in several different dimensions. The mutual impact on other economic sectors and societal developments also should be considered. The society needs to consider a range of key aspects, such as:

- The transition requires **a deep understanding of the needs and demands** of all stakeholders, it implicates everything from the individual citizen, small and large businesses and their business models, to governments and other regulatory authorities, all dependent on interlinked systems.

  The complexity of the transport system makes it necessary to have a multi-**modal integration approach** enlarging cooperation between old and new actors in the mobility sector by addressing a service-dominant business model approach in a multi-stakeholder environment.

- **Digitalisation and intelligent solutions will be enablers** for a user-centric approach of seamless travel experience (MaaS) for people as well as clearly improved efficiency and resilience of goods transport. Physical internet concepts contribute where urban and interurban

mobility is connected seamlessly, also in relation to e-commerce and an increasing individualization of loads / parcels.

- **Safety, security and resilience of digitized mobility system** is to be a primary concern not only from the individual's privacy point of view, but also from a goods transport perspective and as a holistic system challenge.

2) Energy Transformation

The worldwide forecast, indicates a gradual but slow growth of sustainable energy, and a continued growth of production of carbon based fuels. It is a primary challenge to counter the climate effects of carbon emissions and reduce the health impacts of emission of pollutants for the population, which is in particular relevant for densely populated areas. While electric vehicles are expected to satisfy the urban transport needs, that is not the only approach in achieving clean cities. Hence, a systemic approach to city-related energy mix concepts has to be supported in various fields of research including traffic and logistics management, minimized transport needs by "city of short distances" and optimized supply chains, waste management (including GHG processing) and of course disruptive powertrain technologies and power delivery concepts.

- **Services and solutions with clean engines and electrification.** Areas like a Zero-vision on emission and lower levels of noise as well as decarbonization, air quality and effective traffic management are crucial to improve livability and a priority for city authorities.

- **Methods and tools for clean mobility support/supporting infrastructure** will become a critical area where responsibilities, technologies, ownership, business models, investments, financing services and maintenance needs to be addressed. Other considerations include energy supply and energy availability.

RESEARCH NEEDS

Based on these transformations the following research needs have been identified, covering system level aspects as well as technologies. Examples are mentioned, to achieve seamless and integrated mobility of people and goods. The needs are addressed from the perspective of different research angles, where some specific topics are repeated for completeness.

- **System Prerequisites**

- **Need for pilots and demos**:

Challenge: To achieve intelligent and trustful mobility services within an automated and/or C-ITS based system in urban, region-wide and long-distance applications there is a need for evidence-based decision processes and disruption management.
Scope: In order to do that, there is a need to test and evaluate new mobility technologies through pilots and demonstrations. To enable efficiency and avoid duplication of tests there is also a need for a higher-level coordination and neutral information collection from all these tests.
Results: Coordinated and target (= insight) oriented tests and pilots as well as their structured insight collection are the base of well-grounded and efficient decision making for research, development and deployment of automated and/or C-ITS based technology.

- **Improved prerequisites for fossil free fleets**:

Challenge: To achieve a fossil free vehicle transport system is an ongoing innovation and scaling business. There exists a high interdependency between several prerequisites to boom/expand/disrupt this area.
Scope: Amongst others, battery management, drivetrain energy optimisation, electric motors, smart navigation including charging locations and charging power availability are topics that the industry

is working on. All these areas need support to improve (at different TRL levels) as well as a harmonized deployment strategy that integrates these developments with user and environmental needs. Furthermore, the entire lifecycle of the solutions and products need to be considered.
Results: The upturn of fossil free fleets (including electric as well as other CO2 friendly powertrains) is a key aspect for the European and worldwide Decarbonisation targets.

- **Design of new policies and regulations:**

Challenge: An ever faster pace of new, emerging technologies generate a gap between such technology-enabled solutions and system optimal solutions in terms of social, environmental and economic sustainability. Considering the results should be beneficial to the society as a whole and not to particular stakeholders. As an example, solutions would naturally leave out parts of the population who do not have access to/or can afford the new technology (e.g., elderly people).
Scope: We must foster technology development but must steer them to meet system requirements and user needs. Hence, policies, regulations/standards and frameworks for business models need to be designed to enforce such a targeted process. This includes promoting greener transport modes, more efficient mobility for people and goods, and inclusiveness for categories that do not have access to technology.
Results: If we manage to achieve the right composition of technology (development) and applications & services we optimise the system as a whole.

- **Integration Aspects**

- **Into the transport system with all modes**:

Challenge: Efficient integration of existing and new modes of transport
Scope: Integration of C-ITS and automation in the mobility and transport system where all modes are considered, including urban as well as extra-urban and inter-urban transport due to the strong interdependencies in a region and between regions must be ensured considering safety-related aspects. Thus, the challenge of system design solutions covering also single-mode and private forms of transportation during emergency times (i.e.. national or local quarantine) have to be accepted and new risk engineering methods for mobility topics have to be developed.
Results: Research must be performed in order to deliver deep understanding of how to design resilient transportation systems that allow all different modes to be utilised efficiently and at the same time as flexible as the users require.

- **Smart logistic concepts**:

Challenge: Continuous growth in e-commerce and urbanisation results in home deliveries in cities growing with double digits, as well as increasing deliveries for commercial purposes. Many initiatives exist in reducing the impact (congestion, emissions) of this growth, like Parcel locker boxes and/or pickup points; City consolidation centres with capability to switch to other modes of transport (electric, bike) for the last mile; bike deliveries, crowd sourced deliveries making use of existing traffic, pooling of delivery assets and free space in private and commercial vehicles, or even to deliver items directly in the customer's car.
Scope: How to secure a positive environmental development, gains in utilization of resources and gains in service time as well as how to maximise the benefit from new logistics concepts, vehicle innovations etc, both for people and goods as well as combinations of these.
Results: New mobility and logistic concepts and application of physical internet principles in various environments and in numerous scales.

- **Data exchange and management**

Challenge: Large amount of mobility data is generated by digitally-enabled mobility devices and service platforms used by for instance municipalities, traffic authorities, mobility and logistics operators, mobility service providers, mobile network operators, organisation of special events and individual mobility facilitation. The variety of players from public and private sector, the legal and

business requirements for sharing data as well as the diversity of the data itself (e.g. geospatial data, trip data, etc.) makes the access and extraction of relevant information and sharing of the data/information a huge challenge.
Scope: These data embed an enormous potential to optimise the operation of the whole mobility system and address the specific user needs. It also can help strategic decision makers to obtain an improved understanding of current and upcoming developments. Constraints like data ownership, business models, privacy, transparency, and fairness for legally-protected users need to be considered.
Results: A common framework of data processing and sharing tools, human and ethics knowledge and AI algorithm engineering methodologies are needed to support the EC mobility community; it will help in understanding the user needs and behaviour to plan, develop and assess operational and reliable mobility services.

- **Infrastructure**

- **Integration of physical and digital infrastructure:**

Challenge: In order to reach the challenging goal of decarbonization of the transport systems, the interoperability of many different systems needs to be secured. Also, increased automation requires closely interlinked physical and digital infrastructures.
Scope: One important aspect in need of further research is how European legislation and incentives can support such interoperability, and what is the need for such commonality across Europe. Specific research needs to relate to how charging and payment can be done in a consistent manner. In addition, how will the interplay between physical and digital infrastructure change due to automated driving, and what specific requirements will that interplay entail.
Results: Interoperability of physical and digital infrastructure are secured as well as harmonised legislation and incentives to support pan-European operations / mobility both for non-autonomous and autonomous vehicles.

- **Implementation and Timing of required digital infrastructure**

Challenge: Secure the implementation and timing of required digital infrastructure.
Scope: Current vs required maturity and implementation levels of technologies, responsibilities, financing, communication infrastructure, C-ITS platforms and their data servers.
Results: The deployment and integration of new mobility services (based on connectivity and automation).

- **Strategic assessments of mobility innovations**

- **User centric mobility - desirability of outcomes:** The aim of (automotive) innovations is to contribute to the welfare of the EU citizens. Such a development requires a deep understanding of the details of individual and societal needs and their implications for (technical, business related or societal) solutions. Furthermore, where innovations may benefit the welfare of the individual, it may at the same time lead to negative impacts for society as a whole resulting by unforeseen application of the innovation (business models), changing preferences & behaviour of users or systemic cross-modal and/or cross sectoral effects.

- **City planning on a systemic level:** City planning involves a multitude of decisions which have long term implications. Population growth and urbanisation have also negative effects like increased traffic congestion. However, technological advancements allow for a new organisation of society which also influences the demand for mobility. For instance, working from home allows for trip avoidance and more flexibility to choose the moment to commute or to travel to a client. Also, mobility innovations themselves, such as automated driving will open up new possibilities leading to additional behavioural changes and a changed modal balance. Cities are increasingly focusing on improving liveability, creating space for the citizens. The city design should on one hand, be shaped around behavioural changes and on the other hand, should influence future

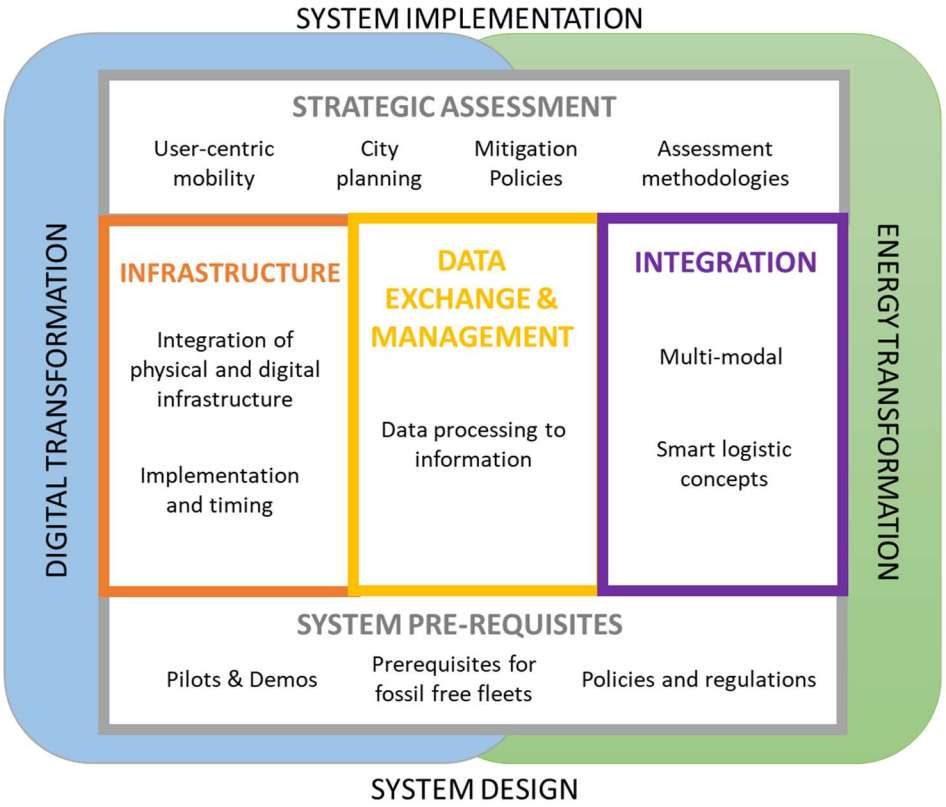
activities of citizens and provide boundaries for the way people will move around in able to reach liveability goals.

- **Transport mitigation policies: pricing, restricting, facilitating, etc**: Besides the guidance of technological innovation (societal pull) also the support of solution deployment is important. To optimally benefit from the advantages that innovations may bring, policy measures should be prepared to facilitate the uptake of innovations to steer their deployment and to mitigate possible negative (side) rebound effects. In the same way, current measures in place may lose their intended effect in case a disruptive solution is available (for instance parking fees in case of an on-demand mobility service). However, the speed and scope of the process of policy making, is usually not matching the accelerated development and uptake of technological innovations.

- **Advanced tools and methods for assessing impacts**: Tools and methods are required to prepare for the upcoming changes and to prepare measures to optimise the welfare effects of the innovations, in particular to ensure a reduction of emissions of greenhouse gases, pollutants and noise. However, disruptive innovations lead to unprecedented effects and therefore cannot be derived from historical data and models calibrated on such data. As additional scenario, models trained on historical data might learn biased patterns that might have negative consequences on the users, such as discrimination. These negative effects of algorithms may be exacerbated in case. In addition, many of the (rebound) effects are not visible when a segmented (modal, sectoral) assessment is done. Interesting research questions in the area of behavioural change are therefore hard to assess and often take many years to unveil the answer by use of historical data. Well-developed alternative tools and methods and an efficient data sharing and assessment are in most cases lacking. These new methods should consider AI and LCA methodologies to overcome these shortcomings.

This leads to the following needs to be addressed:

- An improved and holistic insight is needed on how mobility/automotive innovations can influence the societal challenges to be addressed. Systemic approaches should be identified and be assessed to optimally serve future needs in a citizen-oriented design of cities and integrate new mobility services with the current transport systems. This includes the guidance of technological, societal as well as business model development.
- In order to mitigate undesirable outcomes an improved understanding is needed of the (systemic) effects of uptake of the innovations including an improved understanding of individual and collective (/societal) user needs and driving forces.
- Variation of business models, response of the market/users and mitigating policy measures will lead to multiple possible future pathways. By defining more clearly what is a desired outcome for EU citizens it should be possible to optimise the likelihood to stay on a desired pathway to the future and to avoid the undesired ones.
- Advanced and innovative methods and tools should be developed to be able to timely anticipate upcoming changes and created flexibility to adapt policies in case of unforeseen developments.
- Create methodologies to design these desired pathways to do both, identify potential undesirable trends and set countermeasures at an early stage and detect gaps where we need further (technological, societal or economic) innovations.
- Citizens, businesses and society should all get involved in the design and evaluation of future mobility models, methods and tools through systematic co-creation processes, with the aim to orient mobility planning towards the increase of quality of life in cities/territories.



CONCLUSION

The foresight group members are well represented within the main working groups on future mobility in the European research arena. Thus, a number of these topics have been shared and discussed with key stakeholders such as ERTRAC working groups, ALICE and POLIS among others.

The position paper is well aligned with the European Union priorities and connected to the full set of position papers from EARPA, covering areas such as Connectivity and Automation and Energy, Powertrains and Electrification.

EARPA experts of the foresight group of "Future Mobility of People and Goods" are open to cooperate with other stakeholders to develop these topics further.

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