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# Position Paper on New shared and automated mobility services

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## Summary

Overall mobility and especially in urban and suburban areas faces significant challenges with respect to accessibility, safety, security, impact on environment, service quality of public transport, increasing demand in logistics as well as financing, funding and cost sharing models. Automation of mobility and shared services are key enablers to address these challenges and to offer concrete solutions which are not technically or economically feasible with conventional public transport systems and long haul/urban freight delivery services.

In order to maximise benefits of road automation, it is crucial to think beyond the automated vehicle itself and explore new opportunities at mobility service levels. Shared and automated mobility services are a unique opportunity to bridge the gap between individual mobility needs and community interests by delivering complementary mobility offers integrated with existing high-capacity multimodal public transport.

Some of the most pressing challenges to be addressed are:

- How to create the most suitable framework conditions for successful market introduction and sustainable operations of shared and automated mobility solutions?
- How do we achieve a European wide process to adapt regulatory frameworks to facilitate the introduction of automated mobility
- How can we support the introduction of shared services (e.g. large scale pilots)?
- How can we predict and shape the effects of sharing economy and automation?
  - What could be the effects of the new economy on the mobility organisation?
  - What could be the effects of sharing mobility on the economy?
  - What could be the impact of automated driving on professional driver services management?
  - How will automated driving impact the emergence of new business models for private, commercial and public users?
  - What roles should national and local transport authorities play?
  - How to integrate new shared and automated mobility services with existing public transport and soft modes (walking, cycling)?
  - How to foster innovation and creativity?
  - How to tackle the issue of social inclusion and mobility for all?
  - How will the development of transport automation impact inter-urban and urban logistics mobility in combination with e-commerce?
  - How to adapt and upgrade existing tools and simulation models to analyse mobility demand and to assess impact of new shared and automated mobility services?

In order to make time and cost effective progress towards the deployment of new shared and automated mobility services, future research should address the following issues:

- Safety and security assessment of the overall transport system,
- Verification and validation methods in order to prepare regulation for automated driving
- New hybrid and integrated transport models,
- Overall Cost/benefit analysis of the shared and automated mobility services and business opportunities,
- Modelling and simulation tools dedicated to new mobility services enabled by automated driving,
- User behaviour and adaptation of new mobility services,

- Role of (local) road operators, e.g. (exemptions) for parking regulation of shared cars or dedicated car parks for shared (automated) vehicles,
- Impact on cities and society and new steering instruments,
- Development of innovative, user centric, reliable, fair and ubiquitous mobility and transport services for the local users based on global standards and systems,
- New models and services for sharing of transport assets,
- Explore the potential of combined people and goods vehicles
- Connected and self-organised services for Long Distance Freight Transport,
- Large-scale demonstrations of integrated bundle of shared and automated mobility services using multi-brand and multi-category vehicle fleets.

It is recommended to focus future research activities on the development and demonstration of innovative user-centric mobility services based on low to full automation, not on replication of automated vehicle technology showcases. There is a need to gain more knowledge through demonstrations and pilots of innovative use cases in the large diversity of real-life conditions, in order to progress in terms of standardisation and interoperability, to increase robustness and reliability and to foster replication.

It is also recommended to start with large scale pilots for use cases which are

- most economically relevant
- most technologically ready and realizable

(Mobility concepts consisting on parking, shuttles, constraint area logistics....). These pilots should deal as real business platforms.

## Expected Impact

Research, innovation and deployment of shared and automated mobility services will support competitiveness of European transport industry including vehicle manufacturers, automotive suppliers, public transport operators, freight and logistics, innovative mobility service providers and technology suppliers. It is important to notice that the European ecosystem is composed of many internationally leading industries working in close cooperation with high innovation potential start-ups and SMEs that have the capacity to take global leadership.

Shared and automated mobility services can contribute to make collective transport more effective and tailored to user needs and therefore support local mobility policies in terms of accessibility, social inclusion, multimodality, environment, safety and reduction of road transport externalities.

## Introduction

Overall mobility and especially in urban and suburban areas faces significant challenges with respect to accessibility, safety, security, health, allocation of public space, street design, environment, service quality of public transport, increasing demand in logistics and funding. Shared and automated mobility services have the potential to address these challenges and to offer concrete solutions which are not technically or economically feasible with conventional public transport systems and long haul/urban freight delivery services.

In order to maximise benefits of road automation, it is crucial to think beyond the automated vehicle itself and explore new opportunities at mobility service levels. Shared and automated mobility services are a unique opportunity to bridge the gap between individual mobility needs and community interests by delivering complementary mobility offers integrated with existing high capacity public transport.

Road vehicle automation, from SAE level 4 upwards, will make new mobility services possible thus opening new business opportunities while lowering operational costs. On the other hand, new business models might create disruption for the driver-profession, raise new socio-economic challenges, induce some societal changes and open for new driver roles.

The availability of level 4 driverless vehicles in mixed traffic is being actively prepared. This might have a positive impact on the attractiveness of public transport, and, by providing appealing and convenient means, help accelerate the shift from one-driver car occupancy to multiple passengers shared vehicle solutions. The impact might still be more important in suburban areas, where the use of private cars is still often the only reasonable option.

When fully automated vehicles will become available is still not clear for the foreseeable future, and the position of public policies towards these kinds of solutions is still to be investigated. But in the meantime, a huge range of new services might turn the landscape of public transport and logistics from low cost/low profitability business into a high technology/high innovation-driven playground.

The mobility ecosystem is composed of cross sector stakeholders from public authorities (national and local levels, including cities), transport authorities (national and local levels), operators (public transport and freight & logistics), industry (vehicle manufacturers, transport and infrastructure), vehicle owners, and drivers.

Key technologies to enable transformation of mobility paradigm towards shared and automated mobility include connectivity and digitalization, higher levels of automation from level 4 to enable driverless vehicles, supervision and fleet management systems to enable safe and secure operations of fully automated mobility services.

## Challenges

The landscape of new mobility services is paved with dilemmas, and potentially high value opportunities. Here are the main identified ones:

- **Will highly attractive driverless solutions have a negative impact on the public transport modal shift?**

Admittedly, driverless taxi solutions could provide higher quality, flexibility, comfort and safety for the individual customer. This could potentially lead to a higher number of vehicles with low occupancy (one passenger or zero = empty automated vehicle) on the roads, at the expenses of public transport or walking/biking. The impact on modal share, congestion and health might be dramatic. It is therefore necessary to investigate the combinations of mass transit lines and individual (automated) vehicle services that could keep or better increase the shift to public transport.

- **What are the impacts of new business models and shared economy: will rapid development of P2P and shared services bring additional value to users and operators, but cut existing jobs, with a high social cost?**

There is consequently a need to reconsider the role of human presence in the public transport systems, the value they could bring to the users. Then it will be necessary to define the qualification required and to create the training programmes. The total cost of this evolution on a large scale is not yet evaluated.

- **Public policies at stake: cities and transport authorities should be the first stakeholders of this new mobility approach.**

They could as well foster its deployment within the public transport grids, combine existing public transport offers with new shared mobility services or keep them out of the public scope, with the development of exclusive private approaches only. The impact of these different scenarios on urban planning, and city centres commercial developments are potentially high. Therefore, there should be much more involvement by public stakeholders in the debate.

- **A new era for freight and urban logistics?**

The development of e-commerce might potentially negatively affect the existing network of commercial centres and downtown distribution. This huge trend also requires to reconsider the logistical organisation and distribution for goods delivery, with its usual impacts on congestion, externalities, as well as jobs conversions potentials. This trend would require new models to assess the impacts, as well as the potential improvements expected from road automation.

Here are examples of some of the new possible services enabled by automation:

SAE level	Person mobility urban/suburban area	Person mobility long distance	Freight urban area	Freight long distance
5	On demand Door to door service (robot-taxi), collective taxi services	Seamless intermodal transport solutions	Door to door automated delivery	Driverless trucks
4	On demand shared station based shuttles Ride sharing Free floating and one way car sharing (automated fleet relocation), and car sharing in sparsely populated areas (kerbside and bring system) Last mile on demand services Automated parking	New service concepts (steward instead of driver)	Automated last mile delivery	Fully automated handling of goods / container (ship train, truck, van)
3	Bus platooning	Bus platooning		
2	Bus-stop automation (bus-stop manoeuvring)			Platooning services

There are still remaining challenges to be addressed to create the most suitable framework conditions for successful market introduction and sustainable operations of shared and automated mobility solutions:

- **How do we need to adapt regulatory framework to allow shared and automated mobility services?**

There is also an open question as regards the public policies on new mobility services. This can be easily illustrated by the example of Uber and of all services operated through private platforms. The position might vary from one city to another, and this uncertainty could negatively impact the deployment potential and the operators' business models. It has been stated now that transport regulations do apply to these kinds of platforms.

- **What could be the effect of the new economy on mobility organisation?**

Public transport could be affected by the emergence of P2P mobility services offerings, as taxi drivers have been with the development of Uber, or hotels by AirBnB. Rather than trying to prevent it, public authorities could integrate it in a

holistic view of the transport grid in a city, and take advantage of the new disruptive business models to improve the public transport global funding scheme.

- **What could be the effects of sharing mobility on the economy?**

At least two separate effects of shared and automated mobility services can be identified. The first effect is the impact on the size and composition of the fleet themselves, on the number of vehicles on the road and the number of annual kilometres for each of them – with an impact on the rotation rate, the cost of operations and ownership, and the infrastructure congestion.

The other effect is the impact of potentially hybrid use vehicles to be used for both passengers' transportation, and goods delivery. This should be investigated deeply, as a powerful opportunity for transport operators, and a powerful enabler for better standards of living in the cities (better service with less vehicles on the roads) and in rural areas.

- **What could be the impact of automated driving on professional driver services management?**

The automated driving could have an important impact on the working organization of the truck drivers in long-haul operations (motorways), and lead to a new approach of driving time, resting time, missions planning... New business approaches could be fostered by the innovation.

- **How will automated driving impact the emergence of new business models for private, commercial and public users?**

It could be of interest to explore how connected and automated driving could sustain/improve business models of existing shared mobility services using conventional vehicles.

- **What roles should national, local authorities, and transport authorities play?**

There is an urgent need to engage more public authorities in order to prioritize new mobility services according to national/local transport and mobility policies. Public authorities have a major role to play in facilitating integration of new mobility services into the existing transport systems (e.g. public transport, shared mobility services, parking, logistics, access control...) and in adapting spatial and urban planning to the future evolution of mobility schemes induced by automation.

- **How to integrate new shared and automated mobility services with existing public transport?**

Shared and automated mobility services are a unique opportunity to bridge the gap between individual mobility needs and community interests by delivering complementary mobility offer integrated with existing high capacity multimodal public transport. They can contribute to make public transport more attractive, support modal shift and reduce pressure from the use of private vehicles by offering a well-integrated and cost-effective public transport service with a high frequency and short waiting times, at peak and off-peak periods. Introduction of on-demand and door-to-door services will improve accessibility of public transport services to all users and sustain development of public transport as urban mobility backbone with complementary line services offering viable business models and service flexibility.

- **How to foster innovation and creativity?**

By gaining experience in working together, collaborative activities with public and private stakeholders will help in developing common understanding, creating trust, influencing decisions of policy makers and investors, and strengthening commitment to achieve full scale deployment.

- **How to tackle the issue of social inclusion and mobility for all?**

New shared and automated mobility services should not focus only on highly density populated areas such as cities and contribute to improve mobility for everyone, including communities living in suburbs and rural areas not well connected by public transport.

- **How will the development of e-commerce impact inter-urban and urban logistics?**

Increasing demand for home/office individual deliveries will create opportunities for innovative logistics services enabled by connected and automated driving (e.g. platooning services on main motorway corridors, hub-to-door automated delivery...).

- **How to adapt and upgrade existing tools and simulation models to analyse mobility demand and to assess impact of new shared and automated mobility services?**

Shared and automated mobility services could deliver effective solutions that can't be addressed by manually driven vehicles. However, new methods and tools are needed to investigate the different options enabled by new functionalities provided by the combination of shared mobility services and automated vehicles (e.g. how to adapt dynamically the service provision according to dynamic mobility patterns? How to organise vehicle fleets to deliver timely most suitable services (first/last mile, door-to-door, on-demand...) In which areas?), and they could help to focus efforts on most relevant scenarios.

## Statements

The following statements have been evaluated by the various stakeholders, and through public polls. The results highlight a strong consensus in the following subjects:

- New mobility services will have a disruptive impact on the Business models of mobility (82% agree):
  - New mobility services could transform operations of automated vehicle fleets into a profitable business 82 %  
when, individually, profitability of automated vehicles and vehicle fleets is challenging
  - Shared and automated mobility services require shared governance and shared business models. 82%  
Automated vehicle fleet owners, mobility service providers and supervisors could be different entities.
- New mobility services are strongly dependant on technical operation conditions (78% agree):
  - Safe, secure and reliable operations of automated vehicle fleets rely on supervision systems enabling security control and remote operations of connected and highly automated vehicles in cooperation with the infrastructure, and allowing faster deployment, higher level of security, and higher acceptance by the users. 91%
  - To a lesser extent, it is also stated the the next key milestone will be to remove the on-board driver/steward (with a direct impact on economic viability and user acceptance) are not so consensual 64%
- New Mobility services will require public incentives (73% agree)
  - No single stakeholder will realise the transition to highly automated urban mobility. It needs to be cooperation, guided by strong initiator. 91%
  - Citizens will be reluctant to share vehicles. Therefore strong incentives and policies will have to be proposed to reach a decent level of deployment. 73%
  - New mobility services will need policies. The services, which will have the best prospective impacts, will need to be favoured and those offering negative prospects discouraged and even prohibited (identify preferred scenarios and scenarios to be avoided) 64%

Market forces will not come up with new mobility services by themselves. There is a need for authorities to promote this, not only to guard the constraints. 64 %

- New Mobility services will modify the landscape of transport and mobility organisation, for the people more than for the goods (60% agree)

New mobility services will blur the boundaries between collective and individual services, public and private ones requiring a complete revision of the authorisation process as well as of the fare scheme by transport authorities 100%

A high level of mobility sharing is essential for creating space for in the city centres and reducing traffic jams. 82%

The operation of fully automated vehicles should be reserved to licence-owner (eg. Public transport operator) to make sure that the operator is trustworthy, to make sure that the vehicles will be shared, to avoid congestions and to prioritise services that are useful for the society 55%

However, some statements in this area are no longer consensual :

New mobility services will blur the boundaries between passenger and freight services. The same vehicle can pick up a person delivering to her the parcels she was waiting for and collecting her garbage for her. Public transport, shared transport, freight delivery and reverse logistics will offer the opportunity to be combined in one. These developments sound attractive, but will require many aligned node switches. 37%

The only way to keep our city centres attractive is to adopt a high level of automated mobility. 27%

But there is not a full agreement that taxation could be a tool to foster New Mobility Services deployment in all aspects (55% agree) :

- Taxation has to be changed. HOV (Highly occupancy vehicles) should be privileged in comparison to single- and especially zero occupancy vehicles. 73%
- Develop viable business models and win-win collaboration between public and private actors. Public authorities can decide to define a specific fee/tax to apply to private organisations or Public-Private-Partnerships (PPPs) making use of public road infrastructure to operate innovative mobility services. This fee/tax could be justified to secure proper resource allocation to finance upgrade and maintenance of an appropriate “connected and automated vehicle ready” road infrastructure. 55%
- Public space has to be reallocated from parking space to pick-up / drop-off areas, new lanes for automated vehicles and other public use. That means parking prices have to be raised significantly. 36%

It is also agreed that the following statements can hardly be assessed without a better knowledge of the users' behaviours and acceptance of the new mobility services. A high level of uncertainty still remains in this matter.

- Services can have a major impact on modal choice. The habit of modal choice is, in itself, a barrier to testing new transport means (including public transports or shared transports). New mobility services, by providing intelligence on users' needs, preferences, constraints, and by offering a wider and more flexible choices, can help overcome those barriers. They also provide more detailed information on the mobility context influencing the modal choice (purpose of travel, family size, luggage to carry, having a dog...), and help offering more customized and solutions.
- Users need to gain experience with new services and modal choices, to become aware of their needs and wants, and learn to efficiently use services and modal switches.
- If these barriers could be overcome, services might make new forms of mobility much more affordable than vehicle automation alone.
- There is a role for meta-operators that can make underlying mobility modes transparent for users, and provide a really seamless, comfortable and relaxing experience of multimodality.

As far as safety is concerned, it is also stated that regulation is a serious bottle neck for CAD, particularly in terms of functional safety in urban use. Furthermore, the level of safety expected from CAD by citizens needs to be clarified. But there is an agreement on the fact that operators should be aware of their responsibility towards drivers, passengers, and people on the road.

## Future research needs

- **Safety and security assessment of the overall transport system** (not only connected and automated vehicles) including road and energy infrastructures, supervision, vehicle fleets, service users and other road users by means of physical tests and simulation tools.
- **Verification and validation methods in order to prepare regulation for automated driving**
- **New hybrid and integrated transport models** need to be developed (mix of passengers/freight models, mix of micro/macro simulations, and mix of energy/mobility models...).
- **Overall Cost/benefit analysis of the shared and automated mobility services** integrated with the existing collective transport offer, for all stakeholders (cities, transport operators, new economy players, vehicle manufacturers, users....), and including the social impacts of the new services deployment.

- **Modelling and simulation tools dedicated to new mobility services enabled by automated driving** need to be developed in order to measure and evaluate full scale impacts and to test multiple scenarios in a cost-effective way. These tools can provide great support to cities and transport authorities to define tailored solutions according to local mobility needs and policies.
- **User behaviour and user acceptance/adaptation** needs to be understood for successful roll-out of the right combination of mass-transit and individual (automated) vehicles.
- **Impact on cities and society** and new steering instruments – how will automation affect the mobility, transport networks, resources, street design but also economy, costs and revenues of the city, social inclusion, affordability, city life, health? And how can the public authorities influence those effects in a desired way to reach the overall goals like decarbonisation of transport, Vision Zero etc.
- **Role of (local) road operators**, e.g. (exemptions) for parking regulation of shared cars or dedicated car parks for shared (automated) vehicles.
- **New models and services for sharing of transport** assets to improve transport system utilization and mobility efficiency, preventing incidents, mitigating congestion and improving mobility quality such as predictability and transport mode selection.
- **Explore the potential of combined people and goods vehicles** in order to optimize the use of resources (e.g. fleet, infrastructure) to maximize the social benefit and the cost/benefit ratio.
- **Development of innovative, user centric, reliable, fair and ubiquitous mobility and transport services** for the local users based on global standards and systems.
- **Connected and self-organised services for Long Distance Freight Transport** addressing topics like; data ownership and sharing, traffic network management, public and private data, decision tools, new models for freight transport services towards self-organising LDFT- services.
- **Clear use and business cases of CAD-based smart mobility services**, to allow a greater confidence from all stakeholders (inc. transport operators, cities and transport authorities, manufacturers...) and foster investment.
- **Explore the potentials of CAD-based mobility services and their benefits in the context of countryside, isolated areas, and for socially vulnerable populations**
- **Large-scale demonstrations of integrated bundle of shared and automated mobility services using multi-brand and multi-category vehicle fleets**, all connected to common supervision system (interoperability, standardisation, cooperative traffic management and vehicle routing, safety (e.g. cooperative intersection control), governance, dynamic allocation of vehicles to multiple mobility services...) are necessary to make CAD real and provide citizens with personal experiences.

It is recommended to focus future research activities on the development and demonstration of innovative user centric mobility services based on full automation, not on replication of automated vehicle technology showcases. There is a need to gain more knowledge through demonstrations and pilots of innovative use cases in large diversity of real-life conditions (on public roads in mixed traffic or segregated lanes, on private areas in controlled environment such as airport or sea port) in order to progress on standardisation and interoperability, to increase robustness and reliability and to foster replication.

In addition to providing a more comprehensive understanding of impacts and enablers, this integrated approach would create a database available for research and innovation purposes, to improve all stakeholders' learning curve, and avoid fragmented approaches.



## Expected Impact

Research, innovation and deployment of shared and automated mobility services will support competitiveness of European transport industry including vehicle manufacturers, automotive suppliers, public transport operators, freight and logistics, innovative mobility service providers and technology suppliers. It is important to notice that European ecosystem is composed on many international leading industries working in close cooperation with high innovation potential start-ups and SMEs that have the capacity to take global leadership.

Shared and automated mobility services can contribute to make collective transport more effective and more customized to user needs and therefore support local mobility policies in terms of accessibility, social inclusion, multimodality, environment, safety and reduction of road transport externalities.

