# Intelligent Transport Systems: a Tool or a Toy?
# Working Group reports

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**#ITStoolortoy**

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# Introduction

## Background

A legal framework (Directive 2010/40/EU) was adopted on 7 July 2010 to accelerate the deployment of Intelligent Transport Systems (ITS) across Europe. According to the European Commission's 2011 White Paper on Transport[1], new forms of mobility have to be proposed for overcoming reliability, environmental safety and affordability issues towards sustainable solutions for the transport of people and goods. These solutions will finally contribute to solving global climate challenges correlating to worldwide requirements and standards. At the same time, for the road traffic and safety solution, the European Commission announced the ambitious goal to reduce the number of deaths on European roads by a half until 2020[2].

Research and technology have made significant progress to integrate multidisciplinary approaches and therefore address fragmentation of knowledge in the field of ITS. From this effort, different technology solutions have emerged across Europe and ITS proved to be a tool to make mobility and its objectives effective.

In 2016 the Implementation Report on the 2011 White Paper[3] highlighted that the deployment of interoperable and seamless ITS solutions is still lagging behind the expectations.

The discrepancy between expectations and reality may raise some concerns on whether ITS is a useful tool, or just a toy. This central question was discussed, from different perspectives, during the international conference *"Intelligent Transport Systems: a Tool or a Toy? – Research and innovation opportunities and challenges for autonomous driving and new transport models"*.

## About the conference

The conference "ITS: a Tool or a Toy?" was held in Žilina (Slovak Republic) on 22-23 November 2016 under the auspices of the Slovak Presidency of the Council of the European Union. It gathered 125 participants from 22 European countries and covered diverse stakeholders notably from academia, public and private sectors, European institutions and associations.

The conference was co-organised between the COST Association in Brussels and the University of Žilina, the latter as ERAdiate project on ITS, and ERTICO ITS Europe as a supporting partner.

This event aimed at highlighting the role of research organisations in providing evidence to the policy makers for shaping the right ecosystem in ITS, and to the role of the industry, and in particular SMEs, in delivering innovative, sustainable and interoperable solutions. A special attention was given to two important pillars of future mobility: Autonomous Driving and Mobility as a Service (MaaS), which were discussed in parallel sessions.

In both parallel sessions, two key areas were discussed, namely Research & Innovation (R&I) and Policy aspects. Discussions on R&I aspects focused on questions like: do we need more research? How to create innovation dynamics? What changes are required in the industry landscape in terms of product and systems? The debate on Policy aspects tackled topics such as legal framework and liability, and expected benefits for users and local authorities.

This report has been prepared as a follow-up of the conference and outlines the main conclusions from the two parallel Working Groups (Autonomous Driving and MaaS). It does not pretend to be exhaustive, but rather to highlight the key elements of Autonomous Driving and MaaS. The report is structured as follows: it first highlights the main challenges identified by each Working Group during the discussion. Then, it illustrates the possible routes to address these challenges, and finally it presents specific recommendations to key stakeholders.

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1 https://ec.europa.eu/transport/themes/strategies/2011_white_paper_en

2 https://ec.europa.eu/transport/road_safety/specialist/statistics_en

3 https://ec.europa.eu/transport/sites/transport/files/themes/strategies/doc/2011_white_paper/swd%282016%29226.pdf

# Autonomous Driving

A large number of forward-looking studies on autonomous driving state that the development of autonomous driving solutions will contribute to solve significant issues in transport; for instance by increasing the capacity of transport infrastructure, improving traffic safety, or decreasing Green House Gases emission (e.g. Action Plan Automated Driving, 2016).

## Challenges

### Autonomous vehicles or Automated Road Transport Systems?

National and local authorities must make a choice to what degree they wish to accompany the development of autonomous driving in their capacity to provide the infrastructure for testing and meet the required specifications (Liebermann, 2016). Uncertainty in finding a common political vision on the constituents' needs may prevent to accurately assess priorities in transport and mobility infrastructure. This may not only be costly but also imply negative externalities (Thomopoulos, 2016). The questions arise how to combine the different visions of stakeholders for the benefit of society? And who will bear the costs related to the deployment of autonomous driving?

### Handling Big Data in transport

Big data will be an integral part of future mobility systems. The generation and processing of big data will be key for the functioning of such mobility systems. This opens several questions on autonomous driving. A first one concerns data ownership and format. It is unclear the degree of ownership and the data format that will be adopted by manufacturers and mobility service companies. To what extent will this generated data be made available for the society? A second one is how ensure data security by developing solutions that are robust to cyberattacks. In the light of the first point, this brings the question on how to combine openness of data and secure societies? A third one is the amount of data needed to make reliable predictions: for an ITS solution to provide valuable information, a minimum amount of data and quality is necessary (Kurano, 2016), but this is not always the case. (Lendak, 2016). Yet, even with the right information, it is not clear that more information or more accurate information on traffic will bring positive outcomes as it depends on the way it will be managed (Ciuffo, 2016). The question then arises on how the traffic and network management should accompany / adapt to changes generated by autonomous driving?

### Safety and liability of autonomous driving

Ensuring safety implies that positioning of vehicles will be feasible in every condition. Indeed, no full autonomous driving solution will be safe without a high positioning availability, accuracy and integrity. However, how can we ensure full disclosure of positioning data by operators and manufacturers to ensure safety on roads? (Peyret, 2016). A related question would be whether autonomous driving will be designed to have a driver, and if that was not the case who would bear responsibility in case of an accident: the driver or the manufacturer? If the former was the case, what would be considered as a fair contractual arrangement to ensure the acceptance of the new technology?

### Obtain standardized solutions and sustainable business model

Fragmentation of solutions represents a cost for technology adoption as it impedes interoperability and interchangeability of systems and services. In turn, during the maturity phase of a technology, this discourages innovation, increases duplication of efforts and limits market potential (Eggink, 2016). How to ensure a minimum interoperability without interfering with the innovation process? Pilot cases supported by local authorities is a good option, but how to deploy on a larger scale i.e. EU level? (Blom, 2016).

### Ensure user friendly and citizen-centric technology

It is unclear whether technology push solutions are user friendly if users are not involved in the development process of ITS solutions. Will drivers and passengers accept or adopt autonomous driving systems if they are not fully aware of safety, environment, and mobility benefits? In the same vein, will a consistent message on how to use technology be conveyed by the industry and governments?

## Tackling the challenges

Based on the challenges identified above, the working group proposed their vision and possible approaches to address the challenges.

### Adopt fully autonomous driving

Efforts should not be limited to make vehicles autonomous independently from the system they belong to. Big data in transport is a necessary but not sufficient condition for obtaining a positive outcome. Autonomous

Road Transport Systems should be the final objectives, yet the assessment of costs and who should contribute should be investigated.
The Working Group also advocates that in the long run, no more driver would be required to drive an autonomous vehicle (i.e. Level 5 according to SAE standard J3016)[4]. This implies in parallel to put more effort in developing an autonomous driving system characterized as self-managing (Dusparic, 2016) as improving automation of vehicles does not solve the overall coordination needs of the road transport system (Ciuffo, 2016). In particular it is suggested that the governance of the transport system shifts from an almost fully decentralised approach (as it is today) to a centrally managed approach with the support of local transport authorities to drive the transition. National and Local authorities are therefore invited to engage in defining their vision of Autonomous Road Transport in relation to their constituent's needs. They should also optimise the use of existing infrastructure, and provide an active support of smart mobility pilots and showcases (Blom, 2016).

**Promote open and inter-operable data**

Relevant data stemming from autonomous vehicles should be made open and transparent to be appropriated by innovative actors in the field. This implies that data should be available to ensure safety first, and privacy second (Peyret, 2016). This choice of priority should be accompanied by more research on the capacity of autonomous driving vehicles and systems to respond to cyber-attacks.

**Raise awareness of Autonomous Driving technologies**

Awareness should be raised at all levels (from the education system to general communication campaigns) and that a participatory approach to autonomous driving technology would lower the user acceptance barrier by taking into account different disciplinary perspectives and expectations (DeKort, 2016).

**Seek support at the European level and elaborate common policies**

The fragmentation of technologies is a risk, and interoperability should be systematically taken into account, at least in relation to "safety" functionalities. Regulators and the EC have a strong role to play in ensuring collaboration across states on adopted standards and elaboration of a common policy and support standardisation efforts while involving all relevant stakeholders (Eggink, 2016). Regular communication across R&D programmes should also be ensured. Funding in research and development of Autonomous Driving technologies should be pursued, and a better coordination between different programmes in the field should be stimulated to promote a holistic approach.

## Tackling the challenges

The working group on autonomous driving proposed the following recommendations to key stakeholders

**European Commission**

- Continue to support of R&D and deployment of autonomous driving solutions for better safety, environmental and efficiency results e.g. C-ITS Platform, ETSI ITS-G5 (Menzel, 2016; Kurano, 2016)
- Account for the changes occurring in the industry landscape with the arrival of telecommunication operators in the field, and advocate for an open and transparent data environment in the different initiatives e.g. Gear 2030, dialogue telecom/automotive sector.
- Highlight the importance of social sciences and humanities perspective in funding decisions regarding autonomous driving
- Continue the effort to reach a common European approach on data management and ownership
- Find a good balance between small and large projects in the field.

**Local and transport authorities, ministries in charge of transport**

- Participate actively to the definition of standards, and make stakeholders central in the process, and prioritise on most serious problems such as safety
- Understand the development of autonomous driving as a part of a new mobility ecosystem, and assess the impact on daily practice (DeKort, 2016)
- Anticipate the needs of integration of various intelligent / autonomous systems and services.
- Enable pilot tests on the public road network and provide a specific legal

[4] SAE International, "Taxonomy and Definitions for Terms Related to On-Road Motor Vehicle Automated Driving Systems", International Standard J3016_201401, 2014.

framework for autonomous driving technologies to be tested (Liebermann, 2016, DeKort, 2016)

**Industry**

- Stimulate collaboration between industry and transport authorities
- Consider social science and humanities dimension in the development process of Autonomous Driving (Hauptvogel, R 2016)
- Engage in standardisation at as soon as the technology reaches maturity

**Public and research organisations**

- Pursue efforts in the fields of communication, positioning, cybersecurity and data management. In particular research on the *integrity* of positioning; and robustness of systems to cyber-attacks (Peyret, 2016)
- Focus on research that would enable self-managing properties of autonomic systems. Promote multidisciplinary research including artificial intelligence, machine learning, multi-agent Systems, Game-Theory etc. (Dusparic, 2016)
- Anticipate the effects of autonomous driving and in particular its negative externalities (Thomopoulos, 2016)
- Engage in standardisation processed alongside the industry and transport authorities (Eggink, 2016).

# Mobility as a Service (MaaS)

Mobility as a Service (MaaS) is a paradigm change in mobility, transforming both customer experience and utilisation of physical resources. MaaS brings new transportation alternatives and modes, as well as new digital services for arranging and coordinating effective and efficient planning and use of various travel opportunities. It also impacts city planning, land use, role of public organisations and citizens' welfare.

## Challenges

### Conceptual issues

Although the MaaS concept raised general interest and debate among transport and mobility stakeholders, there is no common view of what MaaS is or should be yet both in terms of definition and mission. Indeed, MaaS currently is a "flexible" concept that can be implemented in different ways. But this flexibility should come at least with a least common denominator from which the minimum operational and functional requirements should be derived. This would support an assessment of MaaS, as its impact on users and transport is currently unknown.

From the public transport system perspective, a real MaaS challenge is to ensure accessibility for all to the system, set an equitable fare system, and reaching a high quality of service request (i.e. the predictability and information, the comfort, and the health issue). For example, while all transport services included commercial ones such as Uber are interested to bring passengers from "a" to "b" in a safe manner, public transport system have also the mission to be accessible for all and clean for the environment

### Opening up transport data / ownership / quality / protection / interoperability

Transport and mobility data are as important for ITS as for MaaS, since there are many heterogeneous stakeholders (users – citizens, enterprises, Internet service providers hosting services, transport providers – public, freight, public authorities – municipalities and regions, MaaS service provider) (Costantini, 2016).

There has been growing momentum for opening up transport data for multiple reasons, including transparency, outreach, optimal use of network, innovation, economic benefit, costs reduction and mutual benefit for both citizens and the public sector. Most local authorities are committed to opening up transport data where technically, legally and financially viable, however, they are not always owners of data and they often lack dedicated resources. Moreover, current systems are not designed for publishing data (Hoadley, 2016).

MaaS could be also potentially used as an integrated surveillance system to which de-anonymisation techniques could be applied (Costantini, 2016). This aspect, often present in the sociological analysis of contemporary information societies, does not seem to be perceived as critical by MaaS actors, perhaps due to the under-representation of social science and humanities experts in MaaS discussions.

Information is useless if it is not up to date, precise and accurate. Who could be liable in Maas since information is gathered and manipulated by so many stakeholders? It is argued that transport data should be public data, but open data apply only to public institutions. So, what if the data owner is a private company or an in-house provider? What happens when the contract ends? (Costantini, 2016).

In terms of data protection, how could personal data be protected in such a complex environment of integrated databases and different stakeholders? (Costantini, 2016).

### Mobility-as-a-Service shifts from purely technical issues to those related with deployment of complex solutions

Are all the entities involved in deployment aware of the issues and the solutions being proposed? Is the regulatory framework adequate for large-scale deployment? Are the administrative and public sector aware of their role in largescale deployment of urban and interurban ITS solutions? Are the business models frameworks ready for production and commercialisation? (Kurano, 2016).

### Demand models

ITS services and solutions have proven the value and impact on macro levels. It has shown further potential, but wide adoption and acceptance by individuals is not yet so clear. Individual users need to see the benefits of ITS in their daily life. Services must adapt to their needs and circumstances at all moments. Mobility in the future must be citizen-centered. But are all the users willing and prepared to make the most of all ITS services? And if so, how can we attract both users and providers to those services? (Kurano, 2016). Mainstream discussion on MaaS seems to implicitly acknowledge "millennials" as the typical MaaS users (Di Ciommo, 2016).

Mobility demand models have considered limited parameters for users' mode choice. What are the additional parameters and how to

use them in mobility models? (Kurano, 2016). To ensure an inclusive MaaS, equity and social inclusion perspectives should be adopted to understand differences in travel behaviour. Apart from highlighting transportation aspects that contribute to inequalities, these perspectives would also allow acknowledging in MaaS what users value about mobility (Di Ciommo, 2016).

## Tackling the challenges

### Conceptual issues and Demand Models

MaaS is not only about mobility, but also about activities. Therefore, it should not be conceived only as "transport/mobility" services, but rather presented in a broader manner as a facilitator of a broader range of activities, all requiring to some extent mobility of people and/or goods (Rohr, 2016). In this respect, MaaS could be conceptualised as a multi-layered "bubble" providing contexts for activity and mobility (Costantini, 2016). Accordingly, MaaS should cover the full 3M spectrum of "motivation, mobility, mindsets". In other words, it should be defined not only in terms of mobility patterns but also in relation to the change of mindsets and motivations linked to mobility. In this respect, there are some indications that affordability and value of time are changing and travel time savings are becoming less important than in the past. Hence MaaS is a fundamental change on how we think our mobility: it builds upon on what already exists (i.e. public transport system) but takes it to the next level (Di Ciommo, 2016).
It is also unclear whether there should be a single or multiple entry points to MaaS. The historical evolution of online social networks could hint on the possible trajectory of MaaS as well. In the initial growing phase, a myriad of online social networks appeared and created a fragmented ecosystem. However, as the area became more mature, this initially broad offer of services (each one with a specific user experience, pricing, privacy approach etc.) became concentrated into a few big market players (e.g. Facebook, LinkedIn, Twitter) (Lugano, 2016).

### Transport data

Quality of services depends on the data available. There is a need of more localized data: crowd-based and social-based information, vehicular, floating, mobile and ad-hoc sensor networks data, and the corresponding Big Data processing tools. It is necessary to extend and integrate the current mobility and safety data structures to facilitate a more comprehensive view of the environment, including aspects relevant to the vulnerable road users. Depending on the application purpose, also data not directly related to mobility could be useful (Kurano, 2016).
Quality of information should be ensured by all the stakeholders involved, hence the quality effort should be shared. Sharing valuable information should be encouraged or at least a legal provision for MaaS participants (Costantini, 2016).
In terms of the information control, there is a need to define criteria for "good" and "bad control. Even those data which are not open should operate on 8 principles of Open Government Data Principles or similar (Costantini, 2016): complete, primary, timely, accessible, machine "processable", non-discriminatory, non-proprietary, license-free.

## Recommendations

### Policy makers / governments

- It is necessary to maximise technology benefits. Policy-makers need to evaluate the possible benefits of new technology to society, taking account of potential multiplicative effects of multiple technologies, e.g. ICT & Automotive Vehicles & MaaS. Governments cannot 'pick the winner', but should invest in technologies that are robust. MaaS has to be part of the "social contract": it should not be left only in the hands of the private sector. Government to set the framework and to regulate and facilitate its deployment.
- In terms of next generation ICT connectivity, governments have to be aware of the quality of ICT services that are necessary to support new technologies and ensure these services are available, across all geographies (Rohr, 2016).
- Support should be provided for development of frameworks to address data governance, value, privacy and security. Brokering discussions on issues related to data ownership and sharing should be encouraged. There is a need to support Open Data initiatives with a focus on societal benefits. Regulatory balance between beneficial uses of data and consumer protection has to be ensured (Rohr, 2016).
- MaaS should be demand responsive, customer oriented, have variable geometry (space and time) and variable pricing (Stussi, 2016).

### Local authorities

- Local authorities have to ensure real-world testing / pilot testing of innovative

solutions, particularly those that bring societal benefits (Rohr, 2016). Europe depends on this trade-off: while open data is local phenomenon, RTTI (EU-wide real-time traffic information services) continuity is the EC objective (Hoadley, 2016).

- Mobility in urban areas must consider all the relevant modes and users: "traditional" (bus, metro, train etc), active (walking, cycling), shared (car-sharing, bike-sharing) (Kurano, 2016). Due to the strong participation, interest and influence of the car industry, MaaS models seem to focus more on optimising the "car + public transport" offer, while they are supposed to include all transport modes.
- To gain the support of cities, it must be ensured that public transport is at the heart of MaaS. Organisational challenges cannot be underestimated, since the current focus seems centred on data and the technology platform. Very few cities (if any) have a dedicated ITS strategy & budget: ITS competes with other transport projects (potholes, cycling lanes) and other municipal services (social services, day care, schools, etc.). It is therefore imperative to have evidence of MaaS benefits for cities.

**Public and research organisations**

- Psychological and behavioural aspects related to shared mobility, Autonomous Driving, and Ownership "Withdrawal" should be investigated further. What matters to the user in terms of services can be broadly influenced by social and cultural factors, as well as by generational differences. A needs-based approach seems more suitable than a preference-based one, with focus on unsatisfied citizen needs, activities and roles. Behavioural research could help in strengthening the accessibility dimension of MaaS (Lugano, 2016). Engaging citizens in co-creation of MaaS applications seem also important to ensure that all needs and user groups are satisfied.
- There is a strong need for new business models, for example for insurance companies, car industry, etc. (no money in information & ticketing) (Hoadley, 2016).
- Another open research field is on the integration of Open transport data and Internet of Things (Bart, 2016).
- All relevant disciplinary perspectives should have the opportunity to contribute to MaaS discussions. In particular, input from Social Science and Humanities (SSH) experts could be further exploit to deploy citizen-centric MaaS taking into account behavioural, cultural and socio-economic aspects.

# Final Remarks & Acknowledgements

The discussions confirmed that Autonomous Driving and Mobility as a Service (MaaS) are conceptually different and at diverse stages of maturity, although both are regarded as pillars of future mobility.

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