

Large scale introduction of automated transport Which legal and administrative barriers are present?

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Abstract

The CityMobil project “*Towards advanced transport for the urban environment*” aims at achieving a more effective organisation of urban transport, resulting in a more rational use of motorised traffic with less congestion and pollution, safer driving, a higher quality of living and an enhanced integration with spatial development (1). This should be achieved by promoting the introducing of advanced technologies into the transport environment. The concepts, methods and tools developed in CityMobil will be validated and demonstrated in a number of different European cities under different circumstances, representing the first stages of automated transport systems that are really integrated in an urban environment.

This paper presents an overview of legal and administrative barriers that detain or are in the way of large scale introduction of advanced transport systems.

Legal and administrative barriers

A number of research questions are based on general open issues or barriers that are known to stand in the way of large scale implementation of advanced transport in cities. Most of these issues were identified in earlier projects (2). These barriers can be of a technological nature, like obstacle detection and avoidance, but there are also issues of traffic management and a number of very important legal and institutional issues to be addressed. Furthermore there are issues that have not been addressed in these earlier projects and that are mostly related to the seamless integration of new innovative systems in existing environments.

Introducing innovative transport systems in an urban environment is a challenging task. A number of barriers are hindering full scale introduction, and in the following these barriers are discussed.

In the future new vehicles and transport systems will be introduced in urban environments. Future scenarios include the following concepts (3):

- ADAS – Advanced Driver Assistance Systems – for cars
- PRT – Personal Rapid Transit
- Advanced bus systems
- CTS – Cybernetic Transport Systems, divided in two sub-categories: “road-based people movers” and “advanced car sharing”

The vision of CityMobil includes both systems supporting a driver and systems without a driver taking part of the control system of the vehicle.

Technical barriers

There are a number of technical barriers relating to advanced urban transport systems. The importance of the functioning of the system as a whole, and of individual components within it, should be strongly emphasized. Technical barriers relate to the actual functioning of any proposed system;

- System robustness
- System reliability
- System capacity
- General fitness for purpose

Technical barriers appear in two different categories; safe design and safe interaction.

Safe design: includes that the passenger or others should not be harmed by the design of the system or its components.

- Sensors; do the sensors detect obstacles of different kinds at a satisfactory level? For fully autonomous vehicles this is a crucial factor, which has strong implications on safety.
- Vehicles; are the vehicles functioning as expected and has it adequate safety equipments?

Safe interaction: means that the passenger should be safe using the vehicle in ordinary transport. The importance of this part increases with interaction with other traffic; from no interaction with other traffic (separated traffic) to full interaction (mixed traffic).

- Actions; are actions like for instance navigation and collision avoidance performed adequately and as expected?
- Communication; is the communication between involved parties functioning? This includes users, vehicles, sensors, infrastructure, control central, etc.

It is important that all these elements meet the requirements, and that the system is able to meet the various regulations and standards under which the system would have to operate (for instance weather conditions, mixed traffic, different user groups, etc.)

The extent of interaction with other traffic increases the need to place the responsibility for the system. With ordinary vehicles the driver has most of the responsibility. As the driver gives up his or her control over the vehicle to a system, it would be natural to hand over the responsibility to the system as well. In certain concepts there are no drivers, and then the system should take over the responsibility.

No matter how compelling demonstrations at the testing and prototype stage may be, it is only when a complete system is working as intended in normal public use that one can be sure of its quality and reliability of operation, and what its outturn construction and operating costs are.

Lack of harmonization between countries and standardization can be an important barrier against large scale introduction of advanced transport systems. This goes for both system design, involved vehicles and components, and legal framework.

User related barriers

Both the authorities and public have barriers against different advanced and innovative transport systems for various reasons. This manifests itself through investments resistance and lack of general user acceptance in the systems. The barriers can be summarized in the following categories:

Authorities

Operational level scepticism

- Is there someone who can operate and administrate, perhaps also finance, the system in a viable way?
- Can the system coexist with other local transport systems and other traffic?
- Is the system vulnerable for specific weather conditions?

Strategic level scepticism

- Will the system solve all or some of the problems they were intended to, for instance congestion problems, safety levels, pollution?

Technological level scepticism

- Will it work technically?
- What are the consequences if the technology fails?

General Public

Personal level scepticism

- Would drivers and passengers feel uncomfortable using a system which replaces their full control of the vehicle?
- Will all user groups, regardless of their cultural background, driving experience, etc., manage to use the systems as intended?

Society level scepticism

- Would the investment in new systems have a positive or negative impact on the growth of GDP (4)?
- Would the automatic system replace some of the existing workforce, leading to unemployment?

Findings from the Cybermove project support this (5). In the study, findings suggest that public acceptability of automated highway systems in the future will improve if:

- The system is proved 100 % fail-safe
- It is easy to get on and off the motorway safely
- The system operated as a toll – drivers who want to use it have to pay for it
- The infrastructure is made available at no cost to the motorist
- The system was demonstrated and tested on a section of the motorway

There is a need to determine the implications of these systems in mixed traffic with a mixed population of drivers - some of whom are going to be well informed, some of whom already have surrendered a part of their control and others who are not. Therefore, this leads to a problem of unpredictable driver behaviour which could ultimately lead to a reduction in safety.

It is of crucial importance to reduce the public acceptance barriers in order to obtain the fully potential of the new systems. This requires an extensive use of the new systems, and thus a substantial reduction of private car usage.

One of the issues that are often connected to unmanned transport systems is that of security. In times like the present where vandalism and terrorism are issues that cannot be left without consideration the security issue should be addressed.

Organizational barriers

A transport system involves numerous institutions, both public and private, each with their own set of interests. Thus, conflicts of interests might be at hand. This is the situation for conventional transport systems, and would indeed be a challenge with advanced innovative transport systems. Many transport innovations fail because the interests of different institutions cannot be reconciled, leading to inability to implement.

Installation of a new and advanced transport system might have negative impacts on the visual appearance of the city. This could be due to the system's degree of "futuristic appearance", space consume, mismatch with architectural style of historical city centre, noise, etc.

Clearly, successful implementation of any new transport system will largely depend upon how well the project is organised and managed. It is important here that the project has clearly defined objectives and expected outcomes, with which all members of the project team have the same understanding.

Financial risks relate to robustness of cost/revenue forecasts and the likelihood of future financial viability, and of obtaining funding for implementation. There may also be difficulties in constructing robust forecasts for innovative systems. Additionally there may be problems of "believability" even if it can be demonstrated that forecasts are robust. This may belong partly in the political category.

Financial Restructuring refers to the adaptation of existing financial structures or creation of new structures. It applies where the financial structure is hindering the processes of design/planning and implementation. This seems to be the case in situations where municipalities are competing with each other for financial resources.

Legal regulations and liability

Legal and liability barriers can relate to compliance with existing regulations. In the STARDUST project it is identified three topics for which special legal attention must be paid: appeal to circumstances beyond the drivers' control in ADAS-related accidents, the position of the governments as road authorities, and the position of the government as lawmaker (6). The "government" in the first case refers to the national, regional and local governments of Europe, in contrast to the lawmaking apparatus, which is being harmonised at the European level.

The liability of the driver is an important aspect (7). Situations can be imagined in which for example the ADAS system is dependent on communication with other vehicles or the infrastructure. If the driver claims that an aspect of the ADAS communication failed in some way, legal cases could be quite difficult. Proof or reasonable proof of failure (or non-failure) must be established.

The liability of road authorities is not mentioned in the STARDUST project. However, there are some crucial issues, for example the liability for roads that do not meet the requirements that reasonably can be expected for such roads. This liability does not limit itself to the asphalt itself. Road equipment also falls under liability. Any ADAS that in some way falls under road equipment, regardless of who put it there, is the liability of the road authority. ADAS that make use of satellites create another scenario. Signal reception can be influenced by the road itself or structures along the roadside. Norms for the performance of these systems for roads are being developed. Roads which do not meet these norms face a substandard classification, requiring warnings to drivers of the substandard situation (8).

These examples illustrate that legal regulations and liability might represent a barrier against full scale introduction of advanced systems, especially driverless systems. Thus, the legal regulations must be adjusted and supplemented to fulfil the needs related to operate an advanced transport system.

Guideline - Action to be made in order to overcome these barriers

Safety and security

The safety issues for both passengers and everybody outside the vehicles (pedestrians, etc.) are covered in certification procedures.

The difference between automated systems and traditional systems is that there are no drivers or other personnel present that can assist in case of an unsecured situation. We focus on personal safety and protection against vandalism, misuse and terrorism.

Personal safety

Personal safety covers safety against actions performed by a third party. This involves safety of passengers using the vehicles or the access to these.

What can be done to improve personal safety:

- Access control with identification of the passengers
- Monitoring the inside and outside areas with cameras and television systems
- Communication system connecting the passengers with the security company
- The possibility to get exclusive access to a cabin
- Emergency procedures (emergency buttons and alarm systems for instance)
- Lighting
- Information system (operating procedures, maps, status, position, clear emergency procedures and instructions, messages for system behaviour, etc.). The HMI should be easy to understand, even for non-skilled users.

- Information about installed monitoring systems could help prevent possible crimes and misuse

Protection against vandalism, misuse and terrorism

Vandalism is for instance outside attacks on the vehicles, the guidance system or the electronic system by means of viruses. Misuse could be the use of vehicles for purposes they are not meant for, like use as a shelter (by playing children or homeless people), misuse of the obstacle detection by playing children, transporting freight, etc. When considering the threat of terrorists using the system, one could think of a bomb being sent into the urban centre in an unmanned vehicle by a terrorist.

What can be done in general to protect against vandalism, misuse and terrorism:

- Control desk should be present
- Monitoring the inside and outside areas with cameras and television systems
- Recognize occupancy (both people and objects)
- Safe and secure communication with control desk
- Detection of unexpected events
- System to ensure that the vehicle does not move if it is unoccupied or has not been called in an authorized way
- Minimize vandalism possibilities by use of materials, HMI design etc.
- Actions to detect obstacle detection misuse
- Price mechanism and means for payment for identification and minimize “kindergarden” and shelter kind of misuse

What can be done in the specific case of freight use:

- Control desk which monitors the vehicles
- Restriction and qualification system for access to the system (for preventing use for dangerous goods, bombs etc.)
- Exit control and camera system for preventing theft

Privacy

Privacy issues are of relevance for both safety and security issues. Information about privacy sensitive systems should be provided to the public.

Is there a contradiction that you cannot have a fully safe and secure system, while maintaining full privacy?

Problematic issues:

- Cameras inside and outside
- Storing data (access control, misuse)
- All kinds of identification, tracking and tracing
- Different laws among the countries

Legal barriers

Existing legislation

A number of shortcomings of the existing legislation have been identified:

- Public road legislation is based on the presence of a driver responsible for the vehicle
- The fact that there is not a present legislation for driverless system represents a barrier - people do not know which laws will apply
- There is a lack of standardisation and harmonization of existing legislation
- Time frame, efforts and challenge for changing or adding legislation could be significant, and therefore represents a barrier

There are a number of elements missing. We need legislation for these.

Other barriers

Organizational barriers

Important organizational barriers include:

- Political issues
- Lack of information and knowledge (dissemination work)
- Funding issues (support demonstrations)
- Acceptance issues (dissemination work)
- Business issues
- Operator issues

Some of these can be addressed, and will be addressed within the CityMobil project.

Societal barriers

Scepticism at an operational, strategic, technological, personal, and society level are present. Some of these aspects can be addressed. For instance, reduced number of jobs related to vehicle operation will be compensated by increased number of jobs within other areas of driverless systems. Other compensatory actions can be taken in a period of transition.

Acknowledgement

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