CONNECTED AND AUTOMATED TRANSPORT

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THE ROAD AHEAD

M. Mitteregger et al., *AVENUE21. Connected and Automated Driving: Prospects for Urban Europe*,
https://doi.org/10.1007/978-3-662-64140-8_1

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CONNECTED AND AUTOMATED TRANSPORT: THE ROAD AHEAD

At least since the turn of the millennium, it has become clear that Europe's cities are facing a rising number of increasingly demanding challenges. Climate change and global technological development are two considerable global drivers that are also governing social change in Europe. These two significant aspects require us to re-examine fundamental questions concerning urban development. They are also set to shape the development pathway of an urban mobility model on the verge of radical change. On the one hand, thanks to automation, we are seeing the development of multiple sensors, and driving assistance and propulsion systems; on the other, digitalization is giving us mobility solutions (MaaS – Mobility as a Service) – controlled via platforms or apps – that cater to and amplify specific demands, thus bringing forth new types of mobility. In a modern, mobile society, transport systems play a crucial role in shaping both objective and subjective assessments of quality of life, and they are inseparably linked to urban development challenges. New technologies and a transformation of mobility based on new mobility types thus also require urban development, urban policy and urban planning actors to rethink their concepts, strategies, measures, processes and instruments.

New mobility technologies offer a whole host of opportunities: digitalization can be an additional tool for urban policymakers and planners, but its potential might only be tapped over time (Giffinger et al. 2018); connected and automated vehicles (CAVs) form a key aspect of smart city strategy design; and comprehensive infrastructural investments in the expansion of digital networks (e.g. 5G and G5 technology), smart curbs and lane or traffic light sensors (Mitteregger et al. 2019) are currently the subject of debate. However, as the ongoing discussion surrounding the concept of the smart city and its existing implementation shows, predictions regarding the impacts of these technologies vary hugely (Hajer 2014, Kitchin 2015, Bauriedl/Strüver 2018, Libbe 2018). In terms of the overall discourse, the need for policy and planning decisions, and problems associated with implementation, certain parallelisms to the somewhat more recent reflections on CAM are emerging.

If assumptions of just how encompassing this looming transformation could be are correct, and the impact of this shift comes close to emulating that of another milestone – the introduction of the automobile – then it is clear that traffic planners will not be the only ones whose minds will be occupied by CAM. The integration of CAVs in the European city (for more on the use of the term "European city", see Chapter 3.2) should therefore be used to reflect on the suitability of and familiar approaches to existing instruments (transport, infrastructures and platforms, as well as management approaches to policy and planning). For this reason, it is crucial to explore and examine – today, not tomorrow – the extent to which new technologies can contribute to the existing goals of sustainable mobility and do so without triggering any unwelcome side effects.

THE OPPORTUNITIES AND RISKS OF CONNECTED AND AUTOMATED TRANSPORT

Connected and automated vehicles are currently the topic of widespread discussion in the media. It is a debate outweighed by reports of technological progress, potential applications and the expectations linked to these innovations in the field of mobility. These articles are accompanied by images of futuristic-looking vehicles and diagrams of connected vehicle networks within a smart city. Even academic publications are dominated by reports on optimized vehicle technologies and the new potential resulting from vehicle-to-vehicle, smartphone and smart home connectivity.

Critical narratives are less common, primarily concern questions regarding the ethics, accountability or authorization of such technological innovations, as well as automated driving systems, and express the population's widespread scepticism. But various scenarios have also given rise to reservations among academics, who cast numerous doubts on the problem-solving potential of CAM. In fact, concerns are being raised that CAVs may not only generate new problems but exacerbate existing ones.

The scientific debate surrounding the future and the impacts CAT will have on the road and settlement structure is dominated by the following points.

- The discourse surrounding CAVs has long been characterized by (successive or disruptive) technological feasibility and/or economic efficiency (Freudendahl-Pedersen et al. 2019). Only recently have there been more frequent considerations

of the possible interplay between economic, ecological and social implications. Thus the spectrum of disciplines that focus on the topic has been expanded (Meyer/Beiker 2014, 2016, 2018, 2019).

- The overwhelming majority of studies examining the effects of CAT focus on transport-related issues (e.g. a greater efficiency of or burden on the transport system, choice of transport) and largely exclude questions concerning planning, policy and society (Milakis et al. 2017, Soteropoulos et al. 2018a).

- "Self-driving" vehicles are often portrayed as the "solution" to all the existing negative impacts and side effects of (urban) mobility: they will supposedly help avoid congestion, reduce accident figures to almost zero, consume less energy thanks to "smart" traffic management and thereby reduce the amount of harmful emissions. Moreover, the technology will allegedly grant independence of movement to persons with reduced mobility and thus make social integration (once again) possible (BMVIT 2016b, 2018, Dangschat 2018, BMVI 2018, POLIS 2018).

- While CAVs are being intensively tested in North American and Asian towns and suburbs, where initial trial operations have been launched (Lee 2018), in European cities, the technology is only being tested on selected routes and at low speeds (8–15 km/h; Boersma et al. 2018, Rehrl/Zankl 2018). Until now, the varied, densely used and rapidly changing streetscapes of Europe's cities mean the situation is still too complex to allow CAVs to be tested.

- The discourse within society and the media and scientific considerations of CAT predominantly refer to the development of vehicle technologies and their connectivity. This discussion is dominated by various engineering disciplines and vehicle manufacturers, as well as globally active companies in the IT industry and business consultancies (Milakis et al. 2017).

- In the media and as part of efforts to market the smart city and "smart mobility", vehicles often appear to be futuristic, luxurious, stylish and elegant. In animated videos, vehicles either glide through a "sanitized" city, which has very few inhabitants and shows no sign of "urban challenges", or they are placed within an expansive outdoor setting, but with the natural world and the environment playing no role other than that of an aesthetic backdrop (Manderscheid 2018).

- The majority of scenarios almost exclusively refer to fully automated driving (SAE Level 5) where, for instance, various levels of market penetration are discussed (usually 10%, 50% and 90%; Soteropoulos et al. 2018a). In addition, these future development scenarios are largely painted from a perspective based on the interests of different actors on the supply side (e.g. the automotive industry, IT sector, network operators; Beiker 2015).

- In addition, models of how streets, junctions and motorways might look in the future are designed with different vehicles being allocated separate lanes, which in reality would result in urban roads that in some places are up to 60–80 metres wide (NACTO 2017). The impacts this design will have beyond traffic itself, such as how pleasant it will be to use the road in question or an increased separation effect, are largely ignored (Mitteregger 2019, Riggs et al. 2019).

- Particularly in advertising, but also within everyday discourses and academic publications, future mobility developments centre around the car (either owned privately or used as part of sharing concepts; Canzler/Knie 2016). Against the backdrop of a generally growing criticism of automobility (and of propulsion systems in particular), these visions of the future aim to craft a new image of the "self-driving" car as a smarter "third space" (alongside people's homes and workplaces).

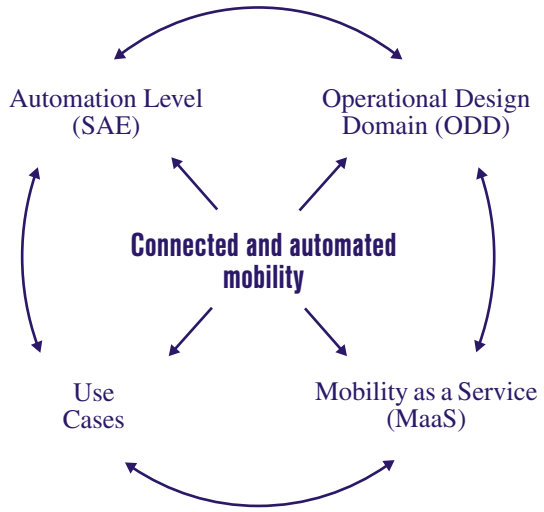
DEFINING THE FOCUS OF THIS STUDY

The subject of this study is the various potential applications of CAVs on roads in individual and public transport as well as in the various hybrid forms of sharing. This is a systematic study, i.e. it includes all other currently known modes of transportation. Applications for freight transport and, above all, in "last mile" urban logistics are considered. Other potential new transport technologies that are expected to play a role in the transport system of the future (such as drones) are explicitly left out of this study.

This investigation analyses the impacts of CAVs on the European city, both regarding the normative framework, which suggests a specific approach to policy and planning and the analytical framework, which comprises criteria regarding urban spaces, sustainable mobility and heterogenous urban society.

We will be examining the most imminent phase of the transition. The areas of action (see Chapter 6.3) concern guidelines that are to be introduced in urban develop-

Figure 1.1: **Aspects of connected and automated mobility**



Source: AVENUE 21

ment within the next five to ten years. It is understood that CAVs will not be able to be implemented uniformly beyond the settlement structure during this phase due to the heterogeneity of roads and their use. Subsequently, phenomena of a social and spatially selective implementation of CAT will be the focus of our observations. This requires a spatially and socially nuanced analysis, and this publication represents the initial steps towards this aim. At the same time, an extensive demand for research is becoming apparent.

Indeed, the overall debate concerning CAM is – as previously mentioned – primarily focused on technological progress (which assistance systems will be available and when?) and the futuristic design of vehicles, especially cars. The assistance systems are divided into groups based on how responsibility for the driving of the vehicle is shared within the human–machine interface. Internationally, these categories are based on the SAE system (SAE International, formerly the Society of Automotive Engineers), the SAE standard J3016 or the BASt (Federal Highway Research Institute) system in Germany. Most previous studies, and above all publications in the media, are limited to these classifications, and in terms of the technological possibilities, concentrate on fully automated driving (SAE Level 5). In this report, however, we will focus on highly automated driving, i.e. Level 4 (SAE 2019, see Chapter 4).

The question concerning when automated vehicles will be authorized is also being discussed in public as well as among researchers. We are thus dealing with an international race being conducted on two fronts: one between companies in the classic automotive and IT sectors to develop the technology, and one between nation states or their subnational authorities (federal states and cities) to authorize such technologies on their roads.

The authorization of various levels of automation primarily depends on their area of application (ODD – Operational Design Domain) such as motorways, rural areas, inner-city districts and industrial estates, as well as further environmental factors, such as the time of day or the weather. Given the myriad complexities of traffic conditions as well as the availability of high-speed internet connections, the decision to authorize the use of automated vehicles over the course of time will primarily depend on how certain situations regarding traffic can be organized in a safe way in mixed traffic environments.

Climate change and congested road networks, however, mean that there is also a need for urban regions in Europe to revolutionize their transport systems. Not only does this require new, post-fossil-fuel forms of transport, but new mobility concepts and behavioural changes. A growing number of digital platforms are appearing that allow various vehicles to be reserved and used for a variety of journeys, the costs to be calculated and for users to exert a certain level of control: MaaS. Car and ride-sharing services are generally considered to play a powerful role in this process. The aim of this transport revolution is thus not to swap current vehicles for "more intelligent" models, but, above all, to completely redesign urban mobility by (1) avoiding travel altogether, (2) shifting to more environmentally friendly forms of transport (active mobility – walking and cycling – and public transport) and (3) improving the quality of public space and transport (A-S-I strategy). Such a shift would drastically change the face of the European city.

As only certain elements of the aspects mentioned here (level of automation, ODD, use cases and MaaS) are discussed or considered in scenarios – and tend to be examined in parallel, not in relation to each other – it seems relevant to always examine these four aspects as a whole (see Figure 1.1).

As the AVENUE21 project has not been designed to quantify future mobility developments in European cities, the aim will not be to compile an "impact assessment" in the classic sense. Rather, the purpose is to outline and attest to the opportunities that are available to a broad circle of actors in urban and mobility planning to play an active role in shaping the upcoming transition.

It is not only the far-reaching consequences of CAM but, ultimately, also the widespread scepticism about the effects of CAT, notably among large parts of the population, (critical) social scientists and especially among transport policy planners at the local level, that make it necessary to discuss the terms under which CAVs are implemented sooner rather than later. The aim should be to avoid any negative impacts on sustainable urban development or for certain subspaces and social groups. It is thus the objective of the AVENUE21 project to develop alternative scenarios for actors in local/regional policy and planning management that clearly point to immediate needs for action but also highlight the possible impacts of various proposed activities.