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The Integration of Driverless Vehicles in Commercial Carsharing Schemes in Germany

A Prefeasibility Study

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Abstract

The prefeasibility study at hand proposes to integrate driverless vehicles in commercial carsharing schemes in Germany. It finds indications that carsharing has the potential to become a significant mode of transport because it responds to social and business change. On the other hand, the study shows that it is the human component in traffic causing the majority of accidents, which is why driverless vehicles are expected to reduce traffic accidents and improve road safety. By making use of the business management tools SWOT analysis and an ad hoc STEPLED analysis, the study conducts a micro-environmental and macro-environmental analysis of the German carmakers BMW and Daimler in regard to the proposed concept. The main finding is that the technology is generally expected to be marketable within the next two decades, if not much earlier. It can be expected that customers will accept driverless vehicle technologies and that many new target groups could be reached by the realisation of the concept. Carmakers should benefit from this potential and might be able to offset possible losses in their core business. The analysis does also show, however, that the current legislation poses several obstacles and might, if unchanged, delay the introduction of driverless vehicle technologies. It is recommended for carmakers to become active and start a public debate similar to the one in the United States. Moreover, it is recommended to collaborate closely with other mobility providers in order to avoid lobbying against the idea.

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Abbreviations

ABS	Anti-lock Brake System
ACC	Adaptive Cruise Control
ACE	Auto Club Europa (Automobile Club Europe)
ADAS	Advanced Driver Assistance Systems
ADAC	Allgemeiner Deutscher Automobil-Club (General German Automobile Club)
AEB	Autonomous Emergency Braking assistant
AHS	Automated Highway System
AltfahrzeugV	Altfahrzeug-Verordnung (End-of-Life Vehicle Regulations)
BAC	Blood Alcohol Concentration
BASt	Bundesanstalt für Straßenwesen (Federal Road Research Institute)
BGB	Bundesgesetzbuch (Civil Code)
BMVBS	Bundesministerium für Verkehr, Bau und Stadtentwicklung (Federal Ministry for Transport, Construction and Urban Development)
BZP	Bundes-Zentralverband Personenverkehr – Taxi und Mietwagen (federal association personal transport – taxi and hire car)
DARPA	Defense Advanced Research Projects Agency
DAS	Driver Assistance Systems
DAT	Deutsche Automobil Treuhand (German Automobile Trust)
DB	Deutsche Bahn (German Railways)
DLR	Deutsches Zentrum für Luft- und Raumfahrt (German Aerospace Center)
DVR	Deutscher Verkehrssicherheitsrat (German Traffic Safety Association)
DRUID	Driving under the Influence of Drugs, Alcohol and Medicines

ESP	Electronic Stability Programme
EV	Electric Vehicle
HAVEit	Highly Automated Vehicles for Intelligent Transport
KBA	Kraftfahrt-Bundesamt (Federal Office for Motor Traffic)
NASA	National Aeronautics and Space Administration
NHTSA	National Highway Traffic Safety Administration
ProdHaftG	Produkthaftungsgesetz (Product Liability Act)
StBA	Statistisches Bundesamt (
STEEPLED	Society, Technology, Economics, Environment, Politics, Legislation, Ethics, Demographics
STEPLED	Society, Technology, Environment, Politics, Legislation, Ethics, Demographics
StGB	Strafgesetzbuch (criminal code)
StVG	Straßenverkehsgesetz (Road Traffic Act)
StVO	Straßenverkehrsordnung (Highway Code)
StVZO	Straßenverkehrs-Zulassungs-Ordnung (National Vehicle Safety Standard)
SWOT	Strengths, Weaknesses, Opportunities, Threats analysis
TAP	Temporary Auto Pilot
UNECE	United Nations Economic Commission for Europe
WP 29	United Nations Working Party 29, the World Forum for Harmonization of Vehicle Regulations
WZB	Wissenschaftszentrum Berlin für Sozialforschur Sciences Berlin)

Introduction

0.1 Overview

The world population recently reached 7 billion people and is expected to rise to 10 billion by 2050 (UN, 2012a [online]). At the same time the share of people living in urban areas has been steadily increasing, from 29% in 1950 to nearly 52% in 2010 (UN, 2012b [online]). Because people move to cities in search of work and a better life (Firnkorn & Müller, 2012 [online]), this number is expected to rise further as well, to more than 67% by 2050 (UN, 2012b [online]). Growing cities are the consequent result of both trends (Firnkorn & Müller, 2012 [online]) and have led to various problems for respective local communities, ranging from poverty and the creation of slums, to water scarcity, health issues or pressure on the local and surrounding environment.

One problem that is shared by urban agglomerations all over the globe is the increasing traffic density. In general, road transportation provides benefits to individuals and societies as a whole, such as enabling economic markets (WHO, 2009 [online]). However, the aforementioned trends concerning population growth and increasing urban populations are accompanied by the process of the motorisation of the individual. In the political East and South this process has, from a historical point of view, just started, while demand for individual motorised mobility in Western and Northern societies has not yet reached full saturation levels (Firnkorn & Müller, 2012 [online]; Shell Deutschland Oil GmbH, 2009 [online]). The consequences of all these trends, however, are negative for the individual and the community. Traffic accidents and the resulting congestion in combination with the increasing traffic density cause mental stress, physical pain and economic inefficiencies (IMechE, 2012 [online]; OECD & ITF, 2008 [online]; Shankar & Singh, 2012 [online]; Straube, 2011 [online]); United Nations (n.d. [online]): people die or get injured in traffic accidents (UNECE, 2012 [online]), properties are damaged (Statistisches Bundesamt, 2012a [online]), noise and exhaust emissions pose a danger to the health of locals (Senatsverwaltung für Stadtentwicklung, 2006 [online]), time of individuals is wasted (Bratzel, 2011 [online]), and the environment is damaged (Union Investment, n.d. [online]). This result, depending on regions, countries and cities admittedly in vastly varying degrees, is expected to worsen further with a continuation of the abovementioned trends. The study at hand suggests a new mobility concept which would make use of carsharing and driverless vehicle technologies,

and has the potential to tackle the abovementioned disadvantages of individualised transport while offering the same and even additional benefits.

0.2 Definitions

Different administrative approaches have been undertaken to tackle traffic-related issues, such as banning specific road users from certain areas (Firnkorn & Müller, 2012 [online]), strengthening public transport (Reidenbach et al, 2008 [online]) or encouraging residents to walk or make use of bicycles (UNECE, 2012 [online]). Private people, associations and companies, on the other hand, may also become a key in contributing to the solution.

One of these grassroots approaches is called carsharing, which is based on the idea that several people can share one car while at the same time enjoying fewer disadvantages compared to possessing an own car. The concept, which started within small groups of private persons, offers a new transport mode with the potential to reduce car ownership and consequently traffic density (Martin, Shaheen & Lidicker, 2010 [online]). These environmental reasons have strongly contributed to the early attractiveness of carsharing (BFE, 2006 [online]) and led to the first schemes in the 1980s, which were organised by associations and clubs (Autotipps.net, n.d. [online]; Schlesiger, 2011 [online]). In these usually small traditional carsharing schemes, customers can find available cars at specific stations in a city and rent them spontaneously or after reservation (Lawinczak & Heinrichs, 2008 [online]). Customers are charged with a monthly basic fee and a price based on rental time or distance, which includes all costs such as petrol, taxes, insurance, maintenance and repairs (Lawinczak & Heinrichs, 2008 [online]).

Increasing numbers of participant and schemes started to indicate a strong market potential (Zhao, 2010 [online]) and eventually attracted corporations who commercialised the idea (Daimler, 2008 [online]; DriveNow, 2011 [online]). In these commercial carsharing schemes, companies increased the flexibility for customers because cars can be parked on all public parking spaces as well as on specific stations (Lawinczak & Heinrichs, 2008 [online]), while customers can find the next available car by using smartphone or internet applications (Firnkorn & Müller, 2012 [online]). Moreover, commercial carsharing schemes distinguish themselves from traditional ones because of their minute-based charging and the absence of monthly fees (Firnkorn & Müller, 2012 [online]) and environmental commitments (Kramper, 2012a [online]).

These current commercial carsharing programmes, the study at hand proposes, should be combined with driverless vehicles, also called autonomous vehicles (Kalra, Anderson & Wachs, 2009 [online]) or robot cars (Davis, 2006 [online]). The technology is not yet sold to the public but recent developments indicate that the technology is likely to be released eventually. Two different approaches can be observed in the development of driverless vehicles.

The first approach is characterised by the development of so-called driver or advanced driver assistance systems (DAS or ADAS) by companies from the automotive industry. These systems like the anti-lock brake system (ABS), the electronic stability programme (ESP) or some more advanced ones like the adaptive cruise control (ACC) and the autonomous emergency braking assistant (AEB), address specific deficits of drivers and seek to make driving saver (Kubitzki, J., personal communication [email], 17/7/2012). With the continuous improvement of existing and the constant development of new systems, it is believed that technologies will gradually improve until fully autonomous driving is eventually achieved (Bohr, 2011 [online]).

The internet search provider Google, on the other hand, aims directly at fully-autonomous driving. The company does not manufacture the cars itself but attaches various sensors and cameras to cars and hopes to be able to improve algorithms, which make sense out of the data which is gathered by sensors and operate the car, until no more human intervention is needed for the driving task (Vanderbilt, 2012d [online]). That this approach could also deliver a marketable product indicates Google's fleet of several driverless vehicles which had travelled almost 500,000 km in August 2012 (Urmson, 2012 [online]). Impressed by this success, United States' Nevada was the first administration in the world to allow the official testing of autonomous vehicles on public roads, whereas Google was the first company to receive a licence under these new regulations (Nevada DMV, 2012a [online]).

While Google has not yet released any official statements on when its technology may be ready to go on sale, the automotive industry widely believes that its approach will lead to marketable solutions at latest within the next 20 years (Bohr, 2011 [online]). Either way, the successful realisation of such technologies is expected to improve the safety of car drivers and other road users such as pedestrians and bicyclists immediately (Urmson, 2012 [online]) and, with more cars making use of this technology, improve the traffic flow and fuel efficiency of the overall traffic in the long term (Kalra, Anderson & Wachs, 2009 [online]).