Social Acceptance of Automated Driving: Some Insights from Comparative Research in Japan and Germany

Torsten Fleischer[1*], Jens Schippl[1], Yukari Yamasaki[1], Ayako Taniguchi[2]

1. Karlsruhe Institute of Technology (KIT), Institute for Technology Assessment (ITAS), Germany

2. University of Tsukuba, Japan

(* Torsten.Fleischer@kit.edu)

Abstract

Policy documents as well the scientific discourse on automated driving regularly make reference to 'social acceptance' as an important prerequisite for the successful adoption and diffusion of this technology. At the same time, this term is surprisingly underconceptualized. In this paper, we discuss various perspectives on the acceptance of AD, propose a definition for social acceptance of a technology and briefly sketch some implications. To back and illustrate our reflections empirically, we present some insights into a recently conducted study comparing governance strategies and related issues of societal acceptance in the field of AD in Japan and Germany.

Keywords: Automated Driving, Social Acceptance, Autonomous Vehicles, Germany, Japan

Introduction

Transportation in most industrialized countries is dominated by road traffic and especially by private motorized transport. It may therefore come as no surprise that the latter is the focus of both political debate and scientific investigation, both in terms of its relevance and its consequences. The current situation is experienced by scientists and politicians as well as citizens as a highly ambivalent matter: On the one hand, many people enjoy the advantages of using individual motor vehicles, but at the same time they feel restricted or inconvenienced by the use of motor vehicles by others: Noise, exhaust emissions, traffic fatalities and injuries, time lost due to high traffic density, devaluation of spaces are typical effects mentioned here.

In addition, automobility also shapes numerous arrangements of social interaction: willingness to be mobile is expected in many professional contexts and spills over into private contexts (childcare, shopping, ...). In many constellations, especially in rural areas, mobility expectations can only be met by using a car. Knowing how to drive is often regarded as a cultural technique similar to reading and writing. As "everyday technology in layman's hands", cars are not only a means of transportation, but also a leisure medium, a means of status presentation, and/or an instrument of social communication.

Individual mobility is highly routinized and habitualized. The use of automobiles to the extent found today has only been possible because a large number of institutional arrangements have co-evolved with it. These include legal systems as well as infrastructures and services, but also everyday practices and social conventions. Externally imposed interventions in these arrangements are often perceived as

unwelcome disturbances and hence are frequently resisted.

Strongly supported by the rapidly advancing digitalization of the mobility sector, improved and also new mobility offers have been developed. Some of these have already been implemented (e.g., car-sharing systems, lending systems for micromobility) or are in pilot phases (e.g., public ridehailing and ridepooling services); others, such as mobility services built around fully self-driving robo-taxis, are not commercialised yet but are usually expected to become part of future mobility systems.

The promise that automated vehicles (AV) will be available soon has entered the arenas of transportation and mobility policy discussions (again) almost a decade ago. According to the protagonists, AVs should, among other things, improve traffic safety (significantly reduce the number of related fatalities and serious injuries), make the handling of traffic more efficient and make it more environmentally compatible overall, enable (individualized) mobility even for those population groups that have been excluded from it up to now for various reasons (age, limitations of physical or cognitive capabilities), and permit new forms of time use while moving around. Not only can substantially conflicting goals be identified behind these expectations - a selective combination of them also allows representatives of essentially different interests and "mobility futures" to recognize "their" future technology in Automated Driving. The wealth of variants of (potentially) possible (new) mobility services is interwoven with a whole number of different automation concepts, which in turn can be differentiated in terms of their technical realizations (and the related technical maturity and performance) as well as in terms of the distribution of tasks between humans and machines in the execution of the driving task (including the observation of the environment and the role as a "fallback level," each with different consequences for responsibility, liability and ethical issues).

There is a broad consensus among technology enactors that AVs, if commercialized sooner or later, will lead to far-reaching changes in the mobility system (and beyond). At the same time, many stakeholders acknowledge that a widespread deployment of AV-based new mobility options depends not only on additional advances in technology itself, but also on its societal embeddedness. The German Automobile Club ACE, e.g., stated in 2015: "*Critical to the future success of autonomous driving is fostering social acceptance for it and allaying unfounded concerns.*" The German Ministry for Transportation and Digital Infrastructure argued in 2017 in its report on the status of implementation of the strategy on automated and connected driving strategy that "*Societal dialogue and the generation of acceptance are key prerequisites for the successful introduction of automated and connected vehicles in public road transport.*" This view was again stressed in its action plan for research on automated and connected driving in 2019: "*One thing is certain: technical progress in the service of safety, sustainability and user-friendliness must not be at odds with affordability, availability and social acceptance.*"

What is surprising from the perspective of innovation and innovation policy researchers is the recurring recourse to "social acceptance", a terminology that is comparatively rarely used in the academic discourses on technology diffusion and adoption, in science and technology studies, innovation research or neighbouring scientific fields. In this paper, we want to discuss some facets of acceptance of AD, propose a definition of social acceptance and briefly sketch some implications. To back and illustrate our reflections empirically, we report on a recently conducted study comparing governance strategies

and related issues of societal acceptance in the field of AVs in Japanese and German context.

Acceptance of technologies

A cursory analysis of the broader research literature on the topic of acceptance in the context of technology, innovation action and socio-technical systems shows that there is still a struggle for a widely accepted definition, although a discourse on this topic has been going on for more than at least two decades. From our point of view, a *prima facie* distinction can be made between acceptance as an individual phenomenon and forms of "collective acceptance". (Arguably, the latter can by no means be merely the summary or averaged version of the former). Second, especially when looking at the "acceptance" of future technology, one can take an empirical perspective ("Will a particular technology be accepted?") based on methodologies developed in traditions rooted in the disciplinary triangle psychology – social sciences – economics or a philosophical-ethical perspective ("Should a particular technology be accepted?"). There are extensive scientific discussions about the strengths, limitations, and mutual relationships of these approaches, which are based on results from various scientific disciplines and have cross-fertilized each other (for a detailed discussion, see, e.g. Grunwald 2005).

Individual acceptance can be expressed in different forms, depending on the technology. One approach, which is particularly applicable when it comes to products or everyday technologies, is the determination of purchasing or usage behavior, which in the case of future technology is usually replaced by the declared willingness to buy (WTB) or to use (Willingness to use, WTU) due to the lack of observable behavior. Strictly speaking, this describes a phenomenon discussed in innovation research as adoption (or willingness to adopt). Rogers (2003) defines adoption as the *"decision to make full use of an innovation as the best course of action available."* Following the same logic, rejection is defined as the "decision not to adopt an innovation". It should be noted that Rogers uses this definition to characterize a single decision, tied to a specific point in time, made by an individual. Especially in the context of consumer research and also in public and political discussion, the concept of acceptance is often linked to the idea of the adoption decision; in the related research literature, the two are frequently used synonymously (in the sense of "whoever buys or uses has also accepted").

In the context of automated driving, however, this leads to several shortcomings. First, Rogers himself already points out that an adoption or rejection decision can be reversed at a later point in time. Negative experiences with a durable product (such as cars) may lead to reversal of purchase decisions or resale of the product; use experiences may also lead to subsequent non-use or rejection. Conversely, initial rejection can also be revised, for example, by learning from positive experiences of other people (e.g. social neighbours). Acceptance thus detaches itself from its definitional binding to the specific decision situation with regard to adoption and rejection and would have to adopt a perspective of the longer-lasting (or permanent) use of an innovation (or, in the case of future technologies, the willingness to do so), including the creation of the necessary conditions for this. This would then also mean to distinguish adoption behavior and acceptance analytically and empirically from each other (even though the two remain *de facto* connected). In addition, innovation research for policy decisions is especially interested in long-term technology uses and patterns. For empirically supported analyses of these trends and of

changes in its determinants (especially changes in relation to initial decisions), longitudinal studies of acceptance behavior would be necessary which are recently only rarely available.

But even if these or other challenges were addressed successfully, the perspective would still be limited to acceptance phenomena of individual adopters. For additional insights, it would be helpful to consider also actor network perspectives. In a *broader business perspective*, social acceptance can be understood as a prerequisite for the successful adoption / diffusion of automated driving technologies and services in order to achieve economic goals of firms (like new products and services, profits, avoidance sunk cost, acquisition of a social license to operate AV-based services or meeting corporate social responsibility targets). In a *public policy perspective*, social acceptance is usually framed as a prerequisite for the adoption / diffusion of automated driving technologies and services in order to achieve related policy goals (like meeting the ‚four societal promises' of AD or strengthening the national innovation system), avoid societal conflicts (potentially) surrounding AV and AD and shape desirable mobility futures. Thirdly, there is an *ethics perspective* on societal acceptance that acknowledges that technology projects are always also social programs and which uses social acceptance as a metaphor for dealing with moral issues, value conflicts and acceptability. Last but not least, there is – intertwined with the other three – a wider innovation studies perspective which starts with the observation that – in contrast to "normal" products or services – automated transportation is designed to be – and expected to be – transformative for the current mobility system.

Transformative innovations can be defined as ideas, artifacts, activities or configurations that explore, develop or represent alternatives to an incumbent socio-technical regime that they seek to challenge, alter or replace (Geels et al 2012). Since this terminology was initially developed in the context of sustainability research and transition management, it was originally linked to the idea that regimes that are (perceived to be) unsustainable have to be replaced by more sustainable ones. It is now more broadly applied to situations where there is a mutually agreed view, and at times even a sense of urgency, among stakeholder that (quasi-) stable socio-technical regimes need to be altered or replaced by a new one that is expected to better meet or solve grand societal challenges. This has consequences for how acceptance should be conceptualized.

Societal Acceptance of automated driving

In a transformative innovation perspective, automated driving will not only have to reach technical maturity for deployment at a larger scale. It also will have to change socio-technical arrangements, be it as a prerequisite for introduction, as a consequence of introduction, or even as a goal of introduction. Some examples for these arrangements that will be affected are presented in the introduction part of this paper. As written previously, many of these arrangements are very stable, highly routinized and habitualized, some of them even emotionally charged. Externally imposed interventions in these arrangements are in many instances perceived as unwelcome disturbances and hence frequently resisted. In this sense, we hypothesize, "acceptance" should also be understood as the willingness of actors affected by these changes to help shape such changes, to support them, or at least to let them happen.

This view would, firstly, expand and differentiate the subjects of acceptance ("Who accepts?"). It would

then not only be about the willingness of citizens to become buyers or users of a product "automated vehicle" or a service "automated driving" - as is the case in many representative surveys today - but also, for example, about the extent to which and under what circumstances they would be willing to accept these uses by others in their immediate living environment, to accept the associated consequences. Beyond this, it might open the perspective for the role of social contexts in mobility and mobility technology choice decisions (Puhe et al. 2021), like the role of social networks in adoption or rejection of certain AD technologies or services. It would also broaden the view to include professional actors, whose "acceptance" in their specific roles in the innovation network is also likely to be of considerable importance for successful adoption/diffusion.

In a further step, additional attention should be given to the role of organizations (like companies, research institutes, civil society organisations, or regulatory authorities) as actors within an innovation network. Which variants of AV technology and services they “accept” (or reject), and why they do so, will shape acceptance heuristics of other individual or professional innovation actors. Another layer of conceptual and empirical complexity is added by the observation that these diverse actor groups may form actor networks of different granularity (e.g. “small” networks of actors like local communities or national governments or “large” network of actors like in national or technological innovation systems) and that these actor networks that may act like single actors in certain contexts (e.g. a family buying a car or a national government in international organizations).

In innovation studies, it is widely acknowledged that the relations and interactions of these actors are regulated by sets of common habits, routines or established practices which are rooted in both informal constraints (sanctions, taboos, customs, traditions, and codes of conduct), and formal rules (constitutions, laws, rights) – patterns that are summarized as institutions (Truffer et al. 2017). It was found that transformative innovations require – almost by definition – to substantially reorganize existing institutional arrangements or even to create new ones. Robust institutional configurations („regimes”) are a reason for technology lock-ins (and lock-outs), hence in many cases innovation actor networks may need to modify existing or „create” new institutions in order to enable new, transformative technologies to diffuse and to be adopted. This, in many cases, induces opposition, resistance or adaptive behaviour among incumbents. For a number of reasons, proponents of transformative innovations may underestimate institutional stability or fail to induce or maintain institutional change, even if the technology itself might be functionally (and/or economically) superior. In the light of this, the ability of innovation actor networks to modify existing or create new institutions (largely) uncontested should be seen as an element of social acceptance. Such a perspective would also attempt to bring acceptance research closer to transformation research.

As it is illustrated in figure 1, a similar broadening of perspective arises for acceptance objects (“What should be accepted?”). An AD function, an AV with certain AD functions (which?), a mobility service based on vehicles with AD functions, the fact that (and the way how) AVs interact with an individual as a (current) non-user in road traffic, the set of rules that determines the behaviour of AVs in the event of a collision (and regulates any consequences), changed daily routines due to changing mobility services and tools, or even a transformed mobility system (or an imaginary thereof) are among the many

possibilities of how "automated driving" is presented, represented or sometimes just imagined in empirical studies as well as in public and political debates.

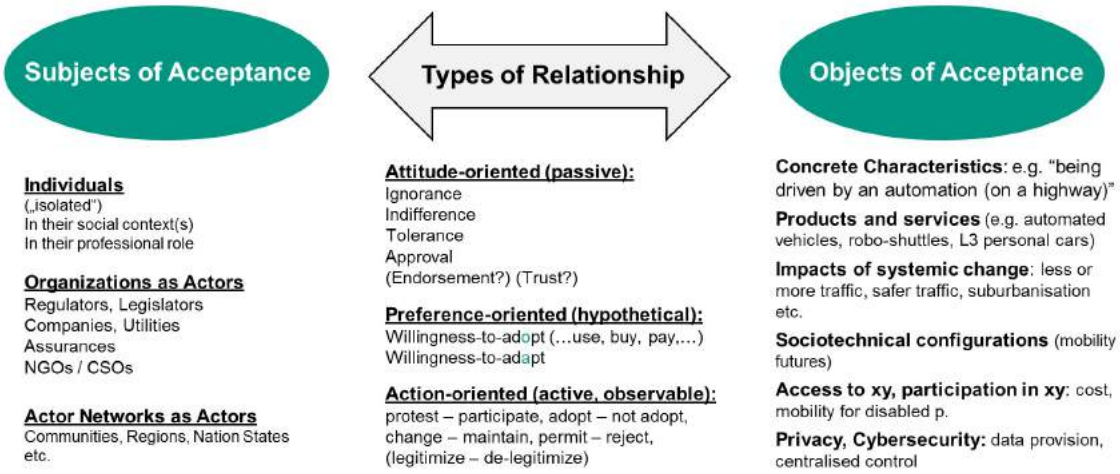

Figure 1 – Relationships between subjects and objects of acceptance in the context of automated driving

Our qualitative research to date shows that citizens' attitudes are often oriented less toward the technology itself than toward associated performance expectations, consequences of use, service concepts, or local "mobility futures." Quantitative surveys in particular must assume that such framings implicitly influence response behavior, but they are not usually made explicit in the methodology (or indeed cannot be captured by it).

The considerations and insights presented above allow to propose a working definition for further research on social acceptance of a technology and to apply this on academic and social discourse about automated driving: *Social acceptance of a technology can be defined as a favourable or positive response (like attitude, stated preference or action) by a given actor group or actor network (e.g. nation state, region, local community, organization), relating to a proposed or emerging technology or an imaginary of a socio-technical regime or socio-technical system modified by this technology, and the reasonable expectation to find explicit or tacit approval of the related processes of its institutionalization within specific spatial-temporal boundaries.*

Investigating social acceptance of automated driving in practice: Some insights from Japanese-German collaborative research

To test these conceptual considerations in a practical context, we have used them in a still ongoing research projects that compares innovation policy practices and public perceptions of AV/AD in Japan in Germany. First insights into the results are presented below.

Early Developments in AV policy

Ideas about automated driving in road traffic can be traced back at least to the 1930s. Since then, the suggestion that automobiles could move without a driver is a recurring motif in depictions of future

transportation worlds. Initially, this was less associated with actual technologies than with utopias and visions that became more concrete over time. In the 1930s and 40s, mass motorization was already taking place in the USA. Traffic jams and dense urban traffic were increasingly perceived as a problem – automation was expected to provide solutions. Serious development efforts to implement these ideas began after the Second World War. The idea of centralized traffic control fits into the planning euphoria of the time. After rather isolated efforts, especially in Japan and the USA in the 1970s, a new wave of vehicle automation activities can be seen in the 1980s. At that time, microelectronics had already found its way into the automobile and automobile manufacturers were open to further applications. At the same time, research and development on "artificial intelligence" – after initial euphoria and intensive government support in the 1960s and massive cutbacks in the 1970s – enjoyed a new upswing. ICT technologies increasingly became the trigger and subject of industrial policy disputes between the major economic nations, especially the USA and Japan. Linked to this were specific application programs, including in the defence sector, which laid the scientific, technical and organizational foundations for many of the subsequent R&D programs for driverless vehicles.

Around the middle of the 2000s – starting with the DARPA Grand Challenge and the private-sector activities it triggered – a "renaissance" of automated driving began. This was, i.a., due to the fact that in the course of technological change in ICT much more powerful and specifically more cost-effective components for automation hardware and software became available. In particular, the further development of sensor technology and the use of machine learning methods should be mentioned here. In countries where globally important players in the vehicle and electronics industry or the so-called platform economy are based, these are considered to be relevant industries for the national economy and enjoy direct and indirect political support.

The development of the current AV policy in Germany

One of the central, if not the most important, early projects in this field for Germany in the 1980s was the research program "PROMETHEUS" (1987-1994). Its aim was to develop an integrated transport concept which, by exploiting the problem-solving potential of new technologies and, in particular, by combining transport engineering with ICT, would reduce the unwanted social and ecological consequences of individual transport and, at the same time, make it possible to continue to exploit its advantages (cf. Prätorius 1993). The work carried out at that time, especially on system analysis and problem definition for the application of ICT in road traffic, had a major impact on further research and development activities in Germany (and beyond) and continues to do so today – probably not least as a result of personal continuity.

In the late 1990s and early 2000s, AD virtually disappeared from the agenda of the German innovation policy but academic and industrial activities continued. In 2009, the German Federal Highway Research Institute (BASt) initiated a project group with the title "Legal implications of Increasing Vehicle Automation", whose final report – published in early 2012 – set the scene for further research and debate. The topic became more publicly visible (again) in 2013 when Mercedes-Benz in cooperation with academic researchers presented a showcase for automated driving by letting a car autonomously drive

the so-called Bertha Benz Memorial Route between Mannheim and Pforzheim. In the same year, the Federal Ministry of Transport and Digital Infrastructure established the Round Table on Automated Driving as an advisory body as well as an arena for close exchange between stakeholders from industry, science, associations and administration – an approach which is typical for the neo-corporatist arrangements of this country. Policy and stakeholder activities culminated in 2015 when the German government adopted and presented its "Strategy for Automated and Connected Driving", which underscored the importance of AD for its industrial and transport policy. The Daimler and Benz Foundation published a comprehensive multi-authored book (Maurer et al. 2016) on the results of the interdisciplinary project "Autonomous Driving - Villa Ladenburg" which could be understood as a scoping process or situation analysis for the societal dimensions of AD. The German Academy of Science and Engineering acatech introduced its position paper “New autoMobility. Automated road traffic of the future”, as did many other industrial associations and stakeholder groups. In the words of innovation research, 2015 can be understood as the year when (informal) national actor coordination was achieved and a so-called “expectation statement” for AD was finalized. It includes four “societal promises” of automated transportation: Improving traffic safety, increasing traffic efficiency, enabling individual motorized mobility for groups previously excluded from it, and changing ("optimizing") the use of time for travellers.

This expectation statement – with linguistic nuances but only slight variations in content – since then pervades policy documents and public statements by innovation actors in Germany and some other industrialized countries. Its existence is also an indicator for the fact that the German national innovation policy makes much greater use of the concept of "mission orientation" than in previous years. Mission orientation embeds technological change in a policy approach that focuses more on the contributions of technical, social and organizational innovations to solving societal challenges that emerge in interaction, and in this context relies, among other things, on inter- and transdisciplinary cooperation, the early involvement of all relevant actors in the innovation system, and cross-sectoral policy coordination for the adaptive coordination of supply- and demand-side strategies and instruments. This becomes also visible in the various incarnations of the High-Tech Strategy, the comprehensive, interdepartmental innovation strategy document of the German government. They discussed intelligent mobility and/or sustainable mobility as important fields of action. In its 2018 version, AV for application scenarios in private transport, public transport, and freight transport are added among the different technological solutions to achieve these goals. This has been supported by various programs for funding technological research as well as numerous activities to understand and shape the societal dimension of AD, such as the establishment of an "Ethics Commission on Automated and Connected Driving" by the Federal Minister of Transport and Digital Infrastructure (2017) or by supporting research into the so-called "non-technical" or "ELSI (ethical, legal and social implication)" earlier and with stronger funding policy support than in past government-supported innovation projects. Beyond this, a policy process to amend or alter the existing regulatory framework has been started. The Act on Automated Driving (Eighth Act amending the Road Traffic Act) which regulated the rights and obligations of drivers using automated driving functions entered into force on 21 June 2017. In spring 2021, another amendment was passed

that regulates the deployment of driverless vehicles in determined operational areas.

Japan

In Japan, political strategies related to automated driving are developed mainly in so-called policy conferences, *seisaku kaigi*[1], which is a form of governance that has been gradually institutionalised in the past two decades. In policy making process in this form, the prime minister or chief cabinet secretary can take initiative in setting up and running meetings, and political actors such as ministers and deputy ministers play an important role in coordinating and deciding on policies; in other words, a mechanism for driving top-down leadership by the core executive (Nonaka & Aoki, 2016). Several policy conferences were established in the Cabinet Office as a result of administrative reforms in the late 1990s, which aimed to eliminate negative effects of vertically divided administration and strengthen the functions of the Cabinet. In addition to those under the Cabinet Office, the number of policy conferences that are directly run by the Prime Minister's Cabinet or the Cabinet Secretariat has been increasing in recent years. The number of personnel in the Cabinet Secretariat have expanded accordingly, which is under the second Abe Cabinet nearly tenfold compared to the period of a quarter of a century ago (Ibid). Detailed and concrete measures for development of automated driving technologies and the social implementation are found in the Public-Private ITS Initiative/Roadmaps and also in the R&D Plan for SIP-adus[2]. At the same time, automated driving is mentioned repeatedly in many other documents thatare drafted in different policy conferences and approved by the Cabinet: Growth Strategy; New Economic Policy Package; Declaration to be the World's Most Advanced IT Nation; Integrated Innovation Strategy; Basic Policy for Overcoming Population Decline and Vitalizing Local Economy, etc. As these policies and strategies go through the process of the Cabinet decision and thereby they exhibit the fundamental policy direction, the roadmaps and the R&D plans are developed in line with the arguments in those documents.

The flexibility of setting of policy conferences enables the government to create a favourable environment to promote policies of the strong interests of each Cabinet at the time. In addition, enhanced influence of the prime minister to the appointments of elite bureaucrats who work for the policy conferences through the establishment of the cabinet personnel affairs bureau in 2014 contributes to keeping the content of deliberations in the conferences strongly reflected the intentions of the Cabinet (Nonaka & Aoki, 2016). For instance, one of the main interests of the Abe Cabinet (2012-2020) was economic policies. This is shown by that, the setting up of the Headquarters for Japan's Economic Revitalization in the Cabinet Secretariat was decided in a Cabinet meeting on the very day of his inauguration of the Prime Minister in 2012, and was abolished shortly after his resignation. The New Economic Policy Package developed in that policy conference in 2017 emphasizes the importance of

[1] There is no official definition for policy conferences. They can be established through the rationales of laws, cabinet decisions, or cabinet approval. The meeting bodies are in many cases named with headquarter or council, and subordinate meeting bodies often named expert committee or working group.

[2] SIP's Automated Driving for Universal Services (SIP-adus) is a Cross-ministerial Strategic Innovation Promotion Program (SIP), coordinated by the Council for Science, Technology and Innovation. The SIP programs promote integrated research and development from the basic research stage to the final outcome by endeavoring to strengthen cooperation among industry, academia and government under the strong leadership of the Program Director.

productivity improvement against a backdrop of dwindling birthrate and an aging population, and autonomous driving is mentioned as something to contribute to it. The expectation of autonomous driving to the productivity improvement appears also often in other documents above mentioned.

Experts, especially industrial players are well represented from policy development to the social implementations. For example, as of July 2020, the executive chairperson of DeNA Co., Ltd. was the member of a policy conferences, in which the Growth Strategies were drafted, and the company was also counted in the Road Traffic WG under the IT Strategy Headquarters to develop the Public-Private ITS Initiative/Roadmaps. Besides, the company's name appears regularly in the practical experiments of automated driving coordinated by the government. Even though industrial players have such official channels to the policy developments, the minutes of meetings of the Road Traffic WG suggest that they rather give comments on the drafts already prepared by the secretariat. There is no change in the outline, but it is more justification of the proposal by the selected bureaucrats who in favour of the Cabinet's direction (see also Kubo, 2016). However, taking into the consideration of the frequent visits to the Prime Minister by public officials and the private sector and many more unrecorded meetings (Machidori, 2015), the processes of the actual policy development, especially in higher level deciding fundamental policy direction, are kept unclear. In this point, such drafts may be written by meticulous preparation after the hidden discussions outside the policy conferences.

Brief analysis of a survey of public perception of AD in Japan and Germany

In order to obtain deeper insights into similarities and differences in perceptions of AV and AD in the general public in Germany and Japan, a cursory online survey was performed in May 2020. It was conducted with 500 respondents each in Japan (in Tokyo and Aichi region) and Germany (in Berlin and NRW region). The full study will be published elsewhere, we will focus here on selected interesting results and interpretations. Regarding the questions asking about the agreements on 14 different arguments[3] for the introduction of AVs in a five-point Likert scales from strongly disagree to strongly agree, 63% to 75% of respondents in Japan selected answer choices of either neutral or agree. Indeed, 30-47% of respondents, depending on the questions, chose the neutral, while the answers in Germany in most cases were much more polarized. This might be because AVs as 'technologies' are perceived positively, or at least not strongly negatively, in Japan for whatever benefits that the technologies may bring to the individuals or to the society as a whole. At the same time, the large proportion of neutral answers points at the difficulties of comprehensibility of yet-to-be-existent technologies. This assumption of rather positive acceptance of AVs as 'technologies' in Japan is reinforced by that the proportions of those who chose disagree or strongly disagree for the questions asking their agreement on different levels of AVs (Level 3, 4 and 5) are much smaller than in Germany, and do not show significant differences between the different levels of the technologies. On the contrary, the stronger

[3] Reduction of traffic accidents among vehicles; Reduction of traffic accidents involving pedestrians; Alleviation of traffic congestion; Support for the elderly going out; Reduction of CO2 emissions; Support for the vulnerable in depopulated areas; Effective use of travel time; Reduction of transport service cost; Solving the shortage of drivers of transport services; Revitalisation of the domestic economy; Not losing to international competition; Governmental investment in the social implementation; Relaxing road traffic regulations for the implementation; AV trials on public roads by the government at the earliest possible time.

dissent in Germany appearing in any argument might be the result of AV technologies being considered as not the right choice for solving the issues presented in the arguments. One might also hypothesize that the apparently solid layer of scepticism in Germany is rooted in a perception of AVs as object of acceptance that is framed more widely than as mere technologies. In addition, the survey also shows that Germans are more sensitive to privacy issues than the Japanese.

A particularly strong difference in the answers between respondents in the two countries is found in the argument: the government should relax road traffic regulations for the implementation of AVs. As shown by the much smaller proportion of disagreement on this argument by respondents in Japan, (de)regulation does not have an a priori negative connotation there. (De)regulation is a tool to achieve goals for the Japanese government, and does not refer to any strong normative implications like in Europe. Rules such as laws and regulations are formulated pragmatically in order to achieve aims, taking the constantly changing conditions in time and space into consideration. Therefore, the information on conditions surroundings will be constantly gathered, and the rules of conduct and actions will be accordingly adjusted (Pauer, 1995). In fact, the outline of the legal system development for automated driving (2018) was developed in a ‘sub’ working group under the Road Traffic WG in the IT Strategy Headquarters. That underlined that perceptions of a new technology can also be shaped by the perceptions of the institutional framework in which these technologies are embedded and how processes of institutional change are managed.

Outlook and recommendations for possible actions

As described above, a broad agreement among many stakeholders appears to exist that social acceptance is a necessary precondition for the successful deployment of AD technologies. At the same time, it is a challenge for both scientific and public discourse that the term is differently defined in different communities and contexts (and sometimes not even defined at all). This is not just an academic problem, it is also of relevance for innovation strategies and public policy in this field. Expectations on social acceptance are formative, they coordinate heterogeneous innovation actors (especially in complex innovation landscapes like mobility) and may shape the actual design of technologies and infrastructures. Understanding the concept of "social acceptance" and its role in public and political discourse about automated driving is therefore a matter worth investigating.

International comparative research is one way to obtain deeper insights into these constellations. This is not only true on a general level, the technological innovation system “automated driving for road vehicles” has some specifics that additionally support this statement. Personal cars are “global products”. A substantial part of them is developed and will most likely be marketed by multinational OEM whose home country is either Japan or Germany and where they and their suppliers play an important role for the respective national economies. At the same time, they operate in different regional markets and have to ensure a level of similarity between these products that allow for sufficient economies of scale. On the other hand, mobility and mobility behaviour are elements of everyday social life which are shaped by numerous regional cultural influences. Even perceptions of the world, ways of identifying and defining problems, or construals of the self, of others and of the interdependence of the

two are known to vary substantially across cultures and world regions. Beyond this, in the light of increasing global mobility, persons from one region (culture) need to be able to master mobility cultures and habits of other regions with almost no time for learning and adaptation.

"Social acceptance" of AD is a complex phenomenon that so far is captured only partially in both research and policymaking, even if one initially keeps analysis and strategy development within the boundaries of a particular region. AD is not "just another technology", it sets out to change socio-technical arrangements, either deliberately, as a consequence of its diffusion and adoption, or both. These arrangements have formed, and are stabilized, as a result of the interactions of a diverse set of societal actors – not just individual buyers or users of a new technology or a transport service based on a new technology but also numerous professional actors who, i.a., develop and sell new technologies, maintain and enhance transportation and communication infrastructures, provide or fund mobility services, decide on the design and operation of urban or regional transportation networks, or write and monitor local and national regulations for dealing with a new technology. All these actors – as individuals, groups, or organizations – are embedded in order structures in the social world that shape and guide their perceptions, preferences and actions. *Systematically mapping and analyzing* these order structures – known as institutions in all social sciences – as well as the respective actor networks would be a first step to better understand the sociotechnical dynamics induced by AD approaching higher levels of technology readiness. From a practical point of view, one will have to start with a group of core actors and then – with growing insights and improved opportunities – systematically expand the analytical framework. As a second step, one should *explore how design characteristics of new mobility options* and related application scenarios (or use cases) *interact with these core institutional dynamics* and especially seek to identify where they might come into conflict with existing institutions. Many of them tend to be stable for usually very good reasons. Needing to modify existing or even to „create" new institutions in order to enable new technologies to diffuse may form a very demanding task for individual innovation actors. It normally exceeds their opportunities and bears the potential to create tensions that may lead to rejection of this technology or even resistance to sociotechnical change induced by it. Especially in these cases, forms of collective action of actor networks have to be found. These will require extensive communication and coordination activities across diverse actor groups. The emergence and stabilization of such forms is demanding and depends on a number of prerequisites. It will have to build in practice, using, among other things, new elements of collective, cross-organizational learning. Test fields, regulatory sandboxes and so-called "real world laboratories" can support this, especially if they are not only dedicated to technical testing under regulatory experimentation clauses, but when all actors use them as an opportunity to gain knowledge about the expectations, adoption conditions and institutional wiggle room of their counterparts in the innovation network. It is to be expected that this will also reveal that different innovation actors perceive and interpret "social acceptance" differently. Reaching a shared understanding that enables coordinated innovation action is a challenging task that requires inclusive moderation by transport policy.

At the same time, a deeper understanding of these factors and their interdependences may enable the *discussion of diverse policy and strategy options*. Industry strategists and transportation policy officials

may use the deeper knowledge about future institutional structures as reference points for developing creative and more robust approaches to their innovation strategies, while researchers and analysts may use it to reveal and reconstruct the assumptions about future institutional context conditions often implicitly made by enactors of specific technological strategies as well as to assess under which conditions these assumptions may be justified. Doing this will help shaping new transportation technologies, including AD, and the mobility system in a way that they support broader societal goals.

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