Mobility for everyone? Possibilities and limitations towards an inclusive market for Connected Autonomous Vehicles

Autoria

Daniel Leite Mesquita - mdleite@gmail.com
65 / UFLA - Universidade Federal de Lavras

Elisa Reis Guimarães - elisa.rguimaraes@ufla.br
65 / UFLA - Universidade Federal de Lavras

Daniel Carvalho de Rezende - rezendedc@gmail.com
Programa de Pós-Graduação em Administração – PPGA / UFLA - Universidade Federal de Lavras

Agradecimentos

The authors thank to PPGA/UFLA and the research participants for all the support in the elaboration of this paper.

Resumo

The research methodology chosen for this paper entails the adoption of a qualitative approach, considering the following research question: How to envisage the possibilities and limitations for the creation of a CAVs' market focused on inclusive mobility? After gathering and analyzing information with experts in CAVs, it is possible to say: This is a nascent industry, which arises from the interaction of two industries: (automotive and digital technologies). This hybridization makes possible the formation of a new knowledge basis, which is essential for the rise and the shape of new markets. It is important to consider all different contexts in which this industry might take place. CAVs markets remain predominantly in the developed world. With the mobility on the transition towards electrification and autonomous systems, inclusive markets should combine: 1) Altering and adapting institutional contexts for provide accessibility and inclusion for CAVs users; 2) Identify consumer's value perception of what could be an inclusive CAV; 3) Implementation of public policies and subsidies for CAVs implementation and fostering inclusive markets; 4) Identification of focal firms, their industry knowledge bases and interactions with other stakeholders (e.g., society); 5) Integration of different visions to provide inclusive mobility and new business models.

Mobility for everyone? Possibilities and limitations towards an inclusive market for Connected Autonomous Vehicles

Abstract: The research methodology chosen for this paper entails the adoption of a qualitative approach, considering the following research question: How to envisage the possibilities and limitations for the creation of a CAVs' market focused on inclusive mobility? After gathering and analyzing information with experts in CAVs, it is possible to say: This is a nascent industry, which arises from the interaction of two industries: (automotive and digital technologies). This hybridization makes possible the formation of a new knowledge basis, which is essential for the rise and the shape of new markets. It is important to consider all different contexts in which this industry might take place. CAVs markets remain predominantly in the developed world. With the mobility on the transition towards electrification and autonomous systems, inclusive markets should combine: 1) Altering and adapting institutional contexts for provide accessibility and inclusion for CAVs users; 2) Identify consumer's value perception of what could be an inclusive CAV; 3) Implementation of public policies and subsidies for CAVs implementation and fostering inclusive markets; 4) Identification of focal firms, their industry knowledge bases and interactions with other stakeholders (e.g., society); 5) Integration of different visions to provide inclusive mobility and new business models.

1. Introduction

Connected autonomous vehicles (CAVs) are a technological innovation which is expected to impact the transport reality soon (Brovarone, Scudellari, & Staricco, 2021; Marletto, 2019). Based on the literature, Da Silva *et al.* (2020) outlined a series of transformations within CAVs technology development and identified five main research trends regarding CAVs: Transportation efficiency and safety; CAVs impact on traffic congestion; CAVs impact on energy consumption and sustainability and recently, mobility services and the consumers` perceptions about CAVs technology. On this last point, Erskine, Brooks, Greer, and Apigian (2020) state that consumer attitudes on CAVs are mostly based on their perceptions of vehicle performance, effort expectancy, social influence (or consumer status) and their hedonic motivations when adopting these vehicles.

CAVs are an opportunity for creating new markets and have the potential to provide transport inclusion for elderly and people with physical restrictions (Günthner, Proof, Jovic, & Zeymer, 2021). Also, people with disabilities (PWDs) could benefit from the development of CAVs markets (Milakis, Van Arem, & Van Wee, 2017; Araujo, Mason, & Spring, 2012).

Therefore, new or emerging technologies can trigger new markets into traditional industries and provide business opportunities. However, all innovations carry a degree of uncertainty. Kapoor and Klueter (2021) point out several gaps and restrictions which should be analyzed and addressed in CAVs' markets and affirm that, from a market perspective, CAVs' industry needs proper regulation, and a more precise appraisal of which business models will be present (e.g., mobility services).

This paper poses the following research question: **How to envisage the possibilities and limitations for the creation of a CAVs' market focused on inclusive mobility, especially for PWDs and elderly ones?**

To address this issue, the theoretical background in this paper refers to the nature of markets (Kjellberg, & Murto, 2021), markets as knowledge infrastructures (Araujo, &

Mason, 2021), market-shaping strategies and hybridization of markets (Nenonen, & Storbacka, 2021; Geiger, & Kjellberg, 2021; Flaig, Kindström, & Ottosson, 2021), and the respective capabilities for market shaping (Nenonen, Storbacka, & Windahl, 2019).

This paper is structured as follows: After this brief introduction, section 2 presents an overview on market studies and Section 3 presents CAVs and its possibilities to create inclusive markets. Next on section 4, the research methodology is delineated, followed by a fifth section presenting the discussion of the research results. At last, section six brings the final considerations, main contributions, and directions for future studies.

2. Markets: creation and shaping

What is a market? In this paper, we bring up the conceptual foundations of market design considering the elements described by Callon, & Roth (2021), who characterize the markets as an array of the following features:

> "It is now established that in order to study markets, their strengths, and their drawbacks, it is necessary to take into account the interventions of (socio)economists and the knowledge they develop and implement, as well as the whole set of technical, legal infrastructures that are designed to frame commercial activities" (…) (Callon, & Roth, 2021: 237).

Hence, market design and performance go beyond the study of the amount of the economic transactions between buyers and vendors. That is, market creation and performance is constantly shaped by diverse legal structures, different knowledge, and technical features (Callon, & Roth, 2021). In this sense, our departure point is to consider the market as a dynamical entity (Kjellberg, & Murto, 2021). As for market actions, the authors provide the conceptual foundation which is developed in this paper:

> (…) markets engage and depend on a much wider set of actors than academic marketing typically recognizes, i.e., beyond buyers and sellers, consumers, and firms (Kjellberg, & Murto, 2021: 2).

In this sense, as far as markets are dynamic, its infrastructure depends on their knowledge basis in several instances. That is, academia, government, and several private actors (firms, research companies, among others) create knowledge and sustain market infrastructure which delivers value from producers to end users (Araujo & Mason, 2021).

Currently, markets are complex, as they deal with integrated and hybrid industries in constant interaction (Geiger, & Kjellberg, 2021). Hence, to study these interactions means to identify varied processes which can shape markets (Geiger, & Kjellberg, 2021; Flaig *et al.*, 2021). For Geiger and Kjellberg (2021:455), innovations within markets represent (…) *"a strategic and selective synthesis of two markets which demands close familiarity with the subprocesses in each, as well as substantial political and networking skills"* (…). Considering CAVs, the market innovations rise from the interactions between automotive and digital industries (Betz, Betz, Kim, Monks, & Phillips, 2019).

Hence, for a proper market shaping, it is necessary to identify the capabilities of firms as well as the institutional features of markets (Nenonen, *et al.*, 2019; Nenonen, & Storbacka, 2021). These elements are essential for the comprehension and agency in the markets. Market shaping relies on technological and socio-technical changes.

Flaig *et al.* (2021) establish the following processes in market shaping: infusion (create changes), formation (modify practices and institutions in the market), and

retention (maintain practices of a market). These processes can occur within markets in a concurrent way from a varied range of actors (e.g., firms and institutions).

For technologies such as CAVs, Flaig *et al.* (2021) argues that this market infuses changes in mobility with the role of firms such as *Tesla* prompting new autonomous technologies into vehicles. Next topic discusses the possibilities for the creation of new inclusive mobility markets.

3. CAVs: Possibilities for inclusive mobility markets

CAVs technology were developed mainly from the early 2000s, when automation technologies of driver assistance were initially incorporated into traditional vehicles. Currently, conditional automation features are present into traditional vehicles. From now until the year 2050, vehicles are expected to be further developed towards totally automated systems. Vehicle automation levels range from 1 to 5 (Table 1), and from level 3 onwards driving systems can monitor the road (Faisal, Yigitcanlar, Kamruzzaman, & Currie, 2019; SAE International, 2021). A summary of these elements is depicted in figure 1:

VEHICLE AUTOMATION LEVELS	FEATURES
Level 1	Vehicles controlled by driver (with driver assistance systems)
Level 2	One driver assistance system is automated
Level 3	Driver can shift safety-critical functions to vehicle
Level 4	Highly autonomous, but not in every driving scenario
Level 5	Fully autonomous, in every driving scenario (no driver required).

Figure 1: CAVs technologies and features.
Source: Prepared by the authors based on Faisal *et al.* (2019) and SAE International (2021).

Wigley and Rose (2020) argue that CAVs are envisaged as a solution for transportation systems, enhancing the safety of drivers, passengers and pedestrians and avoiding traffic congestion in cities. Additionally, they state that CAVs[1] are being promoted as inclusive for all who are unable to drive for several reasons (age, affordability, or disability).

Marletto (2019) describes varied scenarios in which transport and mobility systems are undergoing a conceptual change towards a "social right" that will guide political actions, business models and societies. This conceptual change might be towards electric CAVs with diversifications within transport systems (usage of bicycles, integration of public and private transport systems, presence of shared vehicles). In this sense, it is expected that this context could be "smart" and socially inclusive.

According to the KPMG International (2020) report, European and Asian countries are leading the readiness ranking for CAVs around the world. Moreover, the United States and the United Arab Emirates present a prominent position in the ranking, considering all the categories analyzed in the report (i.e., policy and legislation, technology and innovation, infrastructure, and consumer acceptance). Brazil is placed in the last position in the ranking in all criteria, which prompts the need for development of CAVs technologies for emerging markets.

These aspects provide insights regarding the possibilities for an inclusive market for CAVs technologies. In this sense, the search for a universal design for CAVs, in which

physical and sensorial limitations of consumers are addressed, represents a step towards increasing consumer acceptance (Ferati, Murano, & Giannoumis, 2018).

Kassens-Noor, Cai, Kotval-Karamchandani, and Decaminada (2021), when studying the use of autonomous vehicles in public transport, identified that differences in disabilities interfere with CAVs usage and perception. According to the authors, visually impaired people are more prone to use CAVs than the physically disabled. This element offers a landscape in which different disabilities interfere on consumer's acceptance. Bennett, Vijaygopal, & Kottasz (2019) identified that CAVs could provide independence for the intellectually disabled, but, in contrast, they also reported that feelings of fear and uncertainty are predominant among these consumers.

Looking at the transport inclusion from a macro perspective and considering the physical and sensory limitations of PWDs, there is greater dependence for public transport that disabled people have, in comparison with the non-disabled ones (Kassens-Noor *et al.*, 2021). In this sense, CAVs are already being tested and applied around the world for public transportation using autonomous shuttles (Antonialli, 2021).

There are uncertainties around CAVs adoption for creating an inclusive market. CAVs markets are surrounded by uncertainties or are even seen as mere expectations of the companies wishing to offer benefits of these vehicles for transport inclusion (Milakis, *et al.*, 2017; Wolmar, 2020; Araujo, Mason, & Spring, 2014). Next topic discusses the research methodology of the study.

4. Research Method

The research method chosen for this paper entails the adoption of a qualitative approach based on inductive data collection strategies to find meaningful interpretations by individuals or groups regarding the assessment of complex social problems (Creswell & Creswell, 2018).

There is an inherent social and human complexity when the possibilities for the creation of inclusive markets for CAVs. Dicianno *et al.* (2021) state that accessible and usable design solutions on CAVs should be inclusive in all vehicle features, as well as in the travel journey of its users. In terms of an inclusive market, CAVs adoption and spread should consider the participation of disabled people and elderly individuals (Dicianno *et al.*, 2021; Choromański, & Grabarek, 2015).

In this paper, we considered previous literature in market creation (Nenonen, & Storbacka, 2021) and CAVs' inclusive mobility (Dicianno *et al*., 2021; Choromański, & Grabarek, 2015), proposing a qualitative investigation of the possibilities for the elaboration of an inclusive market for CAVs.

Based on a semi-structured interview script, views and opinions from the participants were gathered and analyzed (Creswell, & Creswell, 2018). The experts were invited to consider the main aspects regarding CAVs and its social implications from an inclusive market standpoint.

As for data collection strategies, considering the restrictions imposed by COVID-19 pandemic when performing qualitative research (Dodds, & Hess, 2020), we carried out an online focus group (Malhotra, Nunan, & Birks, 2017; Hinkes, 2021) along with six professor/researchers experts on CAVs technology and its possibilities of market insertion. Two additional online interviews were carried out with other experts to complement the focus group data. To preserve the confidentiality of the participants' identity, they will, from now on, be referred to as Interviewee 1, Interviewee 2, and so on.

The online focus group and interviews were both carried out and recorded in the *Google Meet* platform between September/October 2021 and lasted on average around 1h30min. The data were transcribed and analyzed considering the aspects of thematic content analysis (Bardin, 2011). The next topic discusses the results of the study.

5. Results and Discussion

This topic presents and discusses which are the main results found in this paper. The results are divided within the following thematic categories:1) CAVs' markets: history and perspectives for an inclusive market; 2) CAVs' hybrid markets: traditional and new mobility; 3) CAVs' inclusive markets: Practices and value creation; 4) CAVs' inclusive markets: Institutional restrictions and triggering market capabilities.

5.1 CAVs' markets: History and Perspectives for an inclusive market

CAVs have risen and started to be seen as a viable technology in the beginning of the 2000s, when the North American government prompted the first investments to spread automated mobility (Gandia *et al.,* 2019). As discussed previously, technology and innovation features for CAVs are paramount in the United States (KPMG International, 2020). These elements are highlighted by the Interviewee 1:

> (....) The history of CAVs starts in the early 2000s, when the American government acts demanding: We need to transform around 1/3 of our terrestrial and aerial fleet into autonomous... The DARPA (US defense department) signals it can do it... Therefore, with government resources, a challenge structure was created in partnership with universities, and in the short term the potential of applications of autonomous technologies into vehicles was perceived... (Interviewee 1).

Projects on CAVs are also being developed both for public and private transportation in North America, Europe, and Asia (Antonialli, 2021; Avenue Project, 2020; KPMG International, 2020). These elements are highlighted by the Interviewee 7:

> (....) What I see is this: what is being developed in terms of CAVs markets is divided into two great streams: The American and the European front (...) In the US, we have noticed that the small vehicles (4 to 5 people) represent the main investment, based on the usage of the private vehicle (...) What do we perceive in Europe? A development of these autonomous technologies by startups for small shuttles for collective transportation (Interviewee 7).

Considering the features of the technology, CAVs are entailed within Product-service systems-PSS (Wang, Zhou, Li, & Budd, 2018; Antonialli *et al.,* 2018). In this feature, the uses, and applications of CAVs may vary in an intermediate status within the range of pure product towards pure transportation services (Antonialli *et al*., 2018). In this paper we consider that the interactions between the user and the intelligent systems of CAVs might demand new mobility services for different applications and users (Wang *et al.,* 2018). These elements are highlighted by the Interviewee 4:

> (....) CAVs have appeared within the product-service system approach with mixed advantages. We can clearly see the benefits of CAVs both as products as well as services. (CAVs) should be visualized beyond their technologies. CAVs

> must be shaped by different demands and expectations of users... (Interviewee 4).

Among the demands and expectations by the interviewee, there is a need for tailoring intelligent systems of CAVs for the demands of different kinds of users (Ferati *et al.*, 2018). In this sense, for the elaboration of inclusive markets, automated mobility technologies must count with the participation of users with specific demands such as PWDs and the elderly (IET, 2017; Dicianno *et al.*, 2021). These elements are highlighted by the Interviewee 6:

> (...) I think that, concerning intelligent vehicles, we are still in the phase "look at the potential we have here for people with disabilities and the elderly" and we have a low comprehension about the particularities we must understand about artificial intelligence and vehicles... We must elaborate designs *for these people* and *with these people*. A proper design to their needs (Interviewee 6).

In this sense, to achieve an inclusive market for CAVs it is necessary to consider it beyond its technological aspects, highlighting: i) The inclusion of users in the whole process of technological development (Dicianno *et al.*, 2021) and ii) the comprehension of CAVs within the entire configuration of mobility industry, considering the diverse social, political and market contexts (Marletto, 2019). These elements are highlighted by the Interviewee 4:

> (...) That's why it is so important to have this integrative vision of a CAV, because we now have so many players. So, this is not a static view of markets... As far as the R&D of companies might exist, it is important to have this integrative vision in all stages of a new technology. This vision relates to the idea of responsible innovation, integrating several voices, with different points of views and needs of society and users (Interviewee 4).

Summarizing, a CAVs inclusive market pervades the creation of new mobility technologies in a participative and integrative view of several actors. In this sense, the innovations and configuration of this market are still in development considering automotive and digital industries. The next topic discusses these elements.

5.2 CAVs' hybrid markets: traditional and new mobility

This topic brings up the elements of the hybridization of markets when considering innovations in industries. The hybridization of markets represents a combination of innovations through the interaction between different markets and their processes (Geiger, & Kjellberg, 2021). Therefore, the main innovations expected in mobility will come from higher incorporation of robotics and artificial intelligence into vehicles (Betz *et al.,* 2019). These elements are highlighted by the Interviewee 8:

> (...) The larger companies in this new sector (CAVs) are the big tech companies: Google, Apple, etc.; they don't have a specific vehicle, but they are researching new digital vehicle technologies, along with startups. Many of these (startups) have partnerships with (or were bought by) traditional automakers which provide for the techs the "car expertise" (Interviewee 8).

It is important to consider CAVs as a technology which prompts new industrial features and ignites social demands (the right to mobility for everyone). In this sense, in

future scenarios of mobility, CAVs can be integrated with diverse transport modes, such as bicycles, public transportation, electric and shared vehicles and so on (Marletto, 2019). These elements are highlighted by the Interviewee 3:

> (...) we have discussed a lot on how CAVs will be implemented in the level 3 or 4 which are now available: shared or electric, and the rate of sharing; different kinds of usage: on demand by apps, robot taxis, private vehicles, or for public transportation bridging gaps in mobility; inaccessible areas where we don't have efficient public transportation., the availability of nocturnal transportation services… (Interviewee 3).

As far as CAVs markets are formed through the interaction of digital and automotive industries. It is important to identify the future practices and value creation processes considering the creation of inclusive markets. The next topic discusses these elements.

5.3 CAVs' inclusive markets: Practices and value creation

Given the context of innovations and new scenarios on mobility, how is it possible to envision an inclusive market for CAVs? Araujo and Mason (2021) argue that markets should be viewed at their knowledge bases, in which, in connection to other markets (hybridization), new practices are elaborated. These elements are highlighted by the Interviewee 1:

> (...) When we see those promotional videos of Uber: They put a man who has lost 90% of his sight inside of a CAV. So, the inclusion is a clear benefit in this discussion. Additionally, new benefits come from driver assistance features, new transportation services and the convergence of digital and physical markets (Interviewee 1).

Hence, for the authors, new markets are made possible when: "*...formed by the emergence of novel forms of expertise that become gradually sedimented into market practices, pervading the private and public sectors* (Araujo, & Mason, 2021:1). Therefore, the rise of new markets presupposes intertwined knowledge among public sector, professional service firms, producers, distributors, and end users (Araujo, & Mason 2021). These practices are necessary for a CAVs inclusive market, and are highlighted by the Interviewee 4:

> (...) We are talking about CAVs insertion into society; So, there are pedestrians, cyclists, etc. All the concerns about a proper and efficient governance on mobility should be considered. The political, and legal questions, etc. It is necessary to integrate all different visions on mobility. (Interviewee 4).

When considering CAVs inclusive markets, we should also think of strategies for value creation when changing customer perceptions of the product (Nenonen *et al.*, 2019). Consumer acceptance and adoption of CAVs is crucial in this process (Hardman, Berliner, & Tal, 2019). These elements are highlighted by the Interviewee 7:

> (...) CAVs are a new technology. So, you must think what value it can deliver for consumers (...) In fact, the aspect of inclusion of PWDs and the elderly is seen as a positive aspect of CAVs. However, this answer (value creation) should come directly from the users: Did they actually perceive it? What we have already observed in empirical studies is that there is still a certain fear of

> adoption concerning CAVs due to the fact there is no driver required (...) (Interviewee 7).

For a proper market shaping it becomes necessary to identify capabilities that might contribute to it (Nenonen *et al.*, 2019). Also, to consider the institutional restrictions and changes of a market it is a paramount factor (Nenonen, & Storbacka, 2021). The next topic discusses these elements.

5.4 CAVs' inclusive markets: Institutional Restrictions and the Market Capabilities

The introduction of new technologies almost certainly involves some aspects of market-shaping, ranging from the development of suitable technical standards to spurring large-scale socio-economic changes (Nenonen, & Storbacka, 2021). This paper considers the triggering capabilities proposed by Nenonen *et al.*, (2019) when shaping a market.

Based on the results previously discussed, CAVs technology and an inclusive market should both attend these prerequisites. That is: **Inclusive mobility must progress in consonance both with society transportation demands, technological advances, and hence give rise to new market structures.** In terms of market structures, CAVs are seen as an element of value creation within the entire mobility system, based on mobility as services (MaaS) and on demand systems (Gandia, 2021) These elements are highlighted by the Interviewee 5:

> (...) MaaS is an adaptable and synergic business model for each different context. Therefore, CAVs can be implemented in several forms aggregating mobility services. In this sense, different benefits might come from different contexts in which CAVs could be implemented. Value creation might come in different ways (Interviewee 5).

Markets are practical outcomes of economic organizing processes involving parallel shaping efforts according to particular templates (Geiger, Kjellberg, & Spencer, 2012). Moreover, the aim of market-shaping is to enhance the value creation and realization for stakeholders in a market mostly leaded by focal firms (Nenonen *et al*., 2019)

As for the triggering capability which changes the network of the industry (Nenonen *et al*., 2019), market-shaping strategies for CAVs market are still in development. That is, firms are positioning in the market when applying their strategies with suppliers (supply side) and defining who will be its participants (provision). These elements are highlighted by the Interviewee 8:

> (...) The automotive industry is changing its way to create and commercialize its goods, such as rent and sharing cars. They are now focusing on a transition to sell **mobility, not just the vehicle**. This will be the future for the new automotive companies. When it comes to CAVs, one interesting example is (focal firm) which produces on demand vehicles, and it is now anticipating the CAVs market with new autonomous technologies and mobility services (...) (Interviewee 8).

Market agents should be equipped for shaping market practices (Geiger *et al.,* 2012). An inclusive market of CAVs represents value creation. In this sense, agents that shape markets (focal firms) must consider: "*a larger system of relevant stakeholders, recognize the institutional arrangements governing their behaviors, and foster new*

resource linkages within and across stakeholders" (Nenonen *et al.,* 2019:1). These elements are highlighted by the Interviewee 2 on the government's role:

> (...) The State must know this technology (CAVs) and should make society aware of it. I bring up the experience with the electric vehicles in France. When the government implements mobility policies it subsidizes around 25% so the automakers could buy (the vehicles), because the first purchaser will be the State. (...) The same strategy could be adopted with CAVs (...) (Interviewee 2).

As previously analyzed, CAVs inclusive markets will become a reality if the conditions which surround focal firms could be modified or shaped (Nenonen *et al.,* 2019). In this sense, there are institutional restrictions (e.g., legal norms, social values, technical standards) which still hampers the possibility of an inclusive market from CAVs adoption. There are also technical standards of industry and legislation that should be altered for the introduction of CAVs into the traditional mobility system (Avenue Project, 2020). This element still represents a restriction considering the social impacts of CAVs on urban mobility and transportation systems (Bagloee, Tavana, Asadi, & Oliver, 2016). These elements are highlighted by the interviewee 5:

> (...) I think the challenges of CAVs are mostly related to all kinds of users, not only for "minorities" (PWDs). If the regulatory mechanisms of accessibility don't prevail, the industries will direct CAVs not for minorities, but for markets they consider more profitable. We are still on this path. (Interviewee 5).

However, a successful market-shaping strategy is not only restricted in reforming or changing institutional context. The **redesign of the exchange mechanisms and the network of the industry** should be considered (Nenonen *et al.,* 2019). Hence, considering the redesign of exchange mechanisms, CAVs inclusive markets should adjust the access to consumers by making it affordable (Cohen, & Cavoli, 2019), and inclusive (Dicianno *et al.,* 2021). These tasks should be developed by focal firms with support of governments. These elements are highlighted by the Interviewee 5:

> (...) CAVs will end up as a plus for PWDs and can provide independence. Which is the market size? Maybe the market itself could not provide the technology development. Public policies for CAVs adoption must be inclusive (Interviewee 5).

At last, it is important to identify social and institutional contexts when adopting CAVs. These contexts could influence a future CAVs' market (Konstantas, 2021). That's the reason why capabilities of reforming institutional context are necessary (Nenonen *et al.*, 2019). This information is significant, considering different social contexts of CAVs implementation projects, such as Avenue Project (2020)[2]. These elements are highlighted by the Interviewee 7:

> (...) In the European Union legal contexts are different for CAVs projects implementation, like Avenue research: Countries like Denmark started CAVs projects two weeks ago. In France, Switzerland, etc., these projects are more developed, due to faster adaptation to legal contexts (Interviewee 7).

To summarize our discussion, Figure 2 characterizes the CAVs market as a hybridization which entails traditional automotive and digital industries. In this sense, different contexts influence CAVs' market practices (value creation and knowledge basis). Therefore, for the rise of an inclusive market for CAVs, focal firms should be

aware of institutional and social contexts in which these markets will develop. Capabilities to modify industry structure, match consumers demand and adapt or alter the legal environment are required when shaping a new market (Nenonen *et al.,* 2019; Flaig *et al.,* 2021).

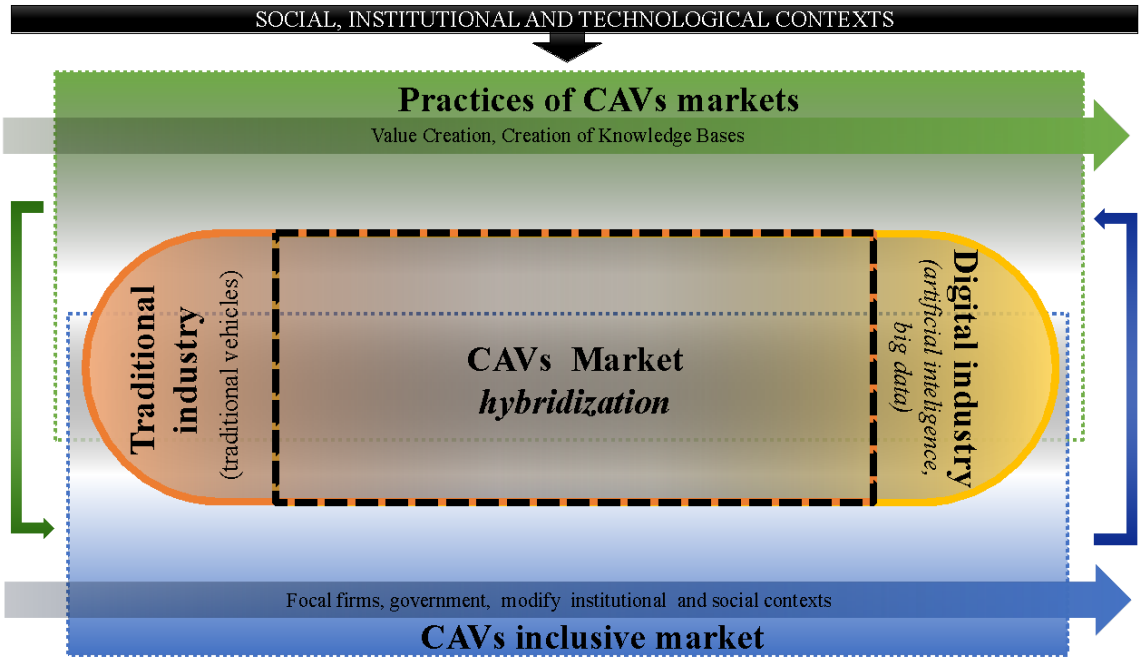

Figure 2: Framework for a CAVs inclusive market
Source: Prepared by the authors.

Observing Figure 2, and after all the results discussed, we sustain that the following actions are needed for shaping an inclusive market for CAVs: i) To alter and adapt institutional contexts to provide accessibility and inclusion for CAVs' users; ii) To identify consumer's value perception of what could be an inclusive CAV; iii) To implement public policies and subsidies for CAVs implementation and fostering inclusive markets; iv) To identify focal firms, their industry knowledge bases and interactions with other stakeholders (e.g., society); and v) To integrate different visions to provide inclusive mobility and new business models (e.g., MaaS).

6. Concluding remarks

This paper has posed the following research question: **How to envisage the possibilities and limitations for the creation of a CAVs' market focused on inclusive mobility, especially for PWDs and elderly ones?** After gathering and analyzing information with experts in CAVs, it is possible to say that this is a nascent industry, which arises from the interaction of two industries (automotive and digital technologies). This hybridization enables the formation of new knowledge basis, which are essential for creating and shaping new markets. It is important to consider all different contexts in which this industry might take place. In this sense, CAVs' markets are predominantly in the developed world. Emerging countries in this market are still only represented by Asian countries.

With the mobility on the transition towards electrification and autonomous systems, inclusive markets for CAVs should combine a synergistic view among new

public policies and strong legislation, to obtain users value perceptions and guarantee their engagement with focal firm's knowledge basis and their stakeholders. Hence, for the rise and the shape of new markets, the proposed framework sought to cover all these aspects. We envisaged an inclusive market in the future considering these elements. However, limitations in technology development, legislations, city infrastructure, industrial contexts and user engagement might hamper the shaping of an inclusive market for CAVs.

Considering the limitations of the study, we highlight the reduced number of interviewees, the impossibility of conducting in-person interviews, and the approach based exclusively on CAVs experts. Future studies can validate the framework proposed with firms, users, governments and so on.

Our study can also contribute to the comprehension of market-shaping phases. Through new value propositions and in specific phases, it is possible to analyze the shape of new markets (Flaig *et al*., 2021). In this sense, future studies should bring up users' perceptions and guarantee their involvement in the shaping and value creation of CAVs inclusive markets.

Endnotes

[1] In this paper we consider CAVs at the levels (3 e 4), as a possibility for offering an inclusive mobility for PWDs or elderly ones providing more capabilities of independence and autonomy. We understand that previous automation levels are closer to the existing traditional vehicles, and the level 5, with no driver required, is still not operational in countries and cities.

[2] Avenue project: It blends conventional public transport with new service models design and carry out demonstrations of urban transport automation by deploying fleets of autonomous minibuses in low to medium demand areas of four European cities (Geneva, Lyon, Copenhagen, and Luxembourg). The project also targets elderly people, people with disabilities and vulnerable users (Avenue Project, 2020).

References

Antonialli, F., Cavazza, B. H., Gandia, R. M., Sugano, J. Y., Zambalde, A. L., Nicolaï, I., & de Miranda Neto, A. (2018). Product-Service System for Autonomous Vehicles: preliminary typology studies. *In the 26th International Colloquium of Gerpisa*, Paris France.

Antonialli, F. (2021). Autonomous shuttles for collective transport: a worldwide benchmark. *International Journal of Automotive Technology and Management, 21*(1-2), 5-28. doi: https://dx.doi.org/10.1504/IJATM.2021.113349

Araujo, L., & Mason, K. (2021). Markets, infrastructures and infrastructuring markets. *AMS Review, 11*, 240–251. https://doi.org/10.1007/s13162-021-00212-0

Araujo, L., Mason, K., & Spring, M. (2012). Self-driving cars: A case study in making new markets. *Big Innovation Centre, Lancaster University*. Retrieved on December 3rd, 2021, from: https://www.bl.uk/collection-items/selfdriving-cars-a-case-study-in-making-new-markets

Araujo, L., Mason, K., & Spring, M. (2014). Expectations in networks: Market Shaping devices of the driverless car. *In the 30th IMP Conference*, Bordeaux, France.

Avenue Project. (2020). Avenue H2020. Retrieved on December 3rd, 2021, from: https://h2020-avenue.eu/summery/

Bagloee, S. A., Tavana, M., Asadi, M., & Oliver, T. (2016). Autonomous vehicles: challenges, opportunities, and future implications for transportation policies. *Journal of Modern Transportation*, *24*(4), 284-303. doi: https://doi.org/10.1007/s40534-016-0117-3

Bardin, L. (2011). *Análise de Conteúdo*. Edições 70.

Bennett, R., Vijaygopal, R., & Kottasz, R. (2019). Willingness of people with mental health disabilities to travel in driverless vehicles. *Journal of Transport & Health*, *12*, 1-12. doi: https://doi.org/10.1016/j.jth.2018.11.005

Betz, U. A. K., Betz, F., Kim, R., Monks, B., & Phillips, F. (2019). Surveying the future of science, technology and business – A 35 year perspective. *Technological Forecasting and Social Change, 144*, 137-147. doi: https://doi.org/10.1016/j.techfore.2019.04.005

Brovarone, E. V., Scudellari, J., & Staricco, L. (2021). Planning the transition to autonomous driving: a policy pathway towards urban liveability. *Cities, 108*, 10296. doi: https://doi.org/10.1016/j.cities.2020.102996

Callon, M., & Roth, A. E. (2021). The design and performation of markets: a discussion. *AMS Review, 11*, 219–239. doi: https://doi.org/10.1007/s13162-021-00216-w

Choromański, W., & Grabarek, I. (2015). Driver with varied disability level – vehicle system: new design concept, construction, and standardization of interfaces. *Procedia Manufacturing*, *3*, 3078-3084. doi: https://doi.org/10.1016/j.promfg.2015.07.854

Cohen, T., & Cavoli, C. (2019). Automated vehicles: Exploring possible consequences of government (non)intervention for congestion and accessibility. *Transport reviews*, *39*(1), 129-151. doi: https://doi.org/10.1080/01441647.2018.1524401

Creswell, J. W., & Creswell, J. D. (2018). *Research design: qualitative, quantitative, and mixed methods approaches* (5th edition). SAGE Publications.

Da Silva, J. P. N., Gandia, R. M., Sugano, J. Y., Oliveira, C. C., Antonialli, F., Pedrosa, G., … & Cavazza, B. H. (2020). From technology to market: a bibliometric and integrative review on autonomous vehicles. *World Review of Intermodal Transportation Research, 9*(1), 1-26. doi: https://dx.doi.org/10.1504/WRITR.2020.106442

Dicianno, B. E., Sivakanthan, S., Sundaram, S. A., Satpute, S., Kulich, H., Powers, E., ... & Cooper, R. A. (2021). Systematic review: Automated vehicles and services for people with disabilities. *Neuroscience Letters, 761*, 136103. doi: https://doi.org/10.1016/j.neulet.2021.136103

Dodds, S., & Hess, A. C. (2020). Adapting research methodology during COVID-19: lessons for transformative service research. *Journal of Service Management, 32*(2), 203-217. doi: https://doi.org/10.1108/JOSM-05-2020-0153/full/html

Erskine, M. A., Brooks, S., Greer, T. H., & Apigian, C. (2020). From driver assistance to fully-autonomous: examining consumer acceptance of autonomous vehicle technologies. *Journal of Consumer Marketing, 37*(7), 883-894. doi: https://doi.org/10.1108/JCM-10-2019-3441/full/html

Faisal, A., Yigitcanlar, T., Kamruzzaman, M., & Currie, G. (2019). Understanding autonomous vehicles: A systematic literature review on capability, impact, planning and policy. *Journal of Transport and Land Use*, *12*(1), 45-72. doi: https://doi.org/10.5198/jtlu.2019.1405

Ferati, M., Murano, P., Giannoumis, G. A. (2018). Universal Design of User Interfaces in Self-driving Cars. In: Di Bucchianico, G., & Kercher, P. (eds). *Advances in Design for Inclusion* (220-228). Springer. https://doi.org/10.1007/978-3-319-60597-5_20

Flaig, A., Kindström, D., & Ottosson, M. (2021). Market-shaping phases—a qualitative meta-analysis and conceptual framework. *AMS Review*, *11*(3), 354-374. doi: https://doi.org/10.1007/s13162-021-00213-z

Gandia, R. M., Antonialli, F., Cavazza, B. H., Miranda Neto, A., De Lima, D. A., Sugano, J. Y., … & Zambalde, A. L. (2019). Autonomous vehicles: scientometric and bibliometric review. *Transport Reviews, 39*(1), 9-28. doi: https://doi.org/10.1080/01441647.2018.1518937

Gandia, R.M. (2021). MaaS as a Catalyst for the Public Transport Revolution in Developing Countries. In: Mira-Bonnardel, S., Antonialli, F., Attias, D. (eds). *The Robomobility Revolution of Urban Public Transport: A Social Sciences Perspective* (181-192). Springer. https://doi.org/10.1007/978-3-030-72976-9_9

Geiger, S., Kjellberg, H., & Spencer, R. (2012). Shaping exchanges, building markets. *Consumption Markets & Culture, 15*(2), 133-147. doi: https://doi.org/10.1080/10253866.2012.654955

Geiger, S., & Kjellberg, H. (2021). Market mashups: The process of combinatorial market innovation. *Journal of Business Research, 124*, 445-457. doi: https://doi.org/10.1016/j.jbusres.2020.11.010

Günthner, T., Proff, H., Jovic, J., & Zeymer, L. (2021). Tapping into market opportunities in aging societies - the example of advanced driver assistance systems in the transition to autonomous driving. *International Journal of Automotive Technology and Management*, *21*(1-2), 75-98. doi: https://dx.doi.org/10.1504/IJATM.2021.113352

Hardman, S., Berliner, R., & Tal, G. (2019). Who will be the early adopters of automated vehicles? Insights from a survey of electric vehicle owners in the United States. *Transportation research part D: transport and environment, 71*, 248-264. doi: https://doi.org/10.1016/j.trd.2018.12.001

Hinkes, C. (2021). Key aspects to consider when conducting synchronous text-based online focus groups – a research note. *International Journal of Social Research Methodology, 24*(6), 753-759. doi: https://doi.org/10.1080/13645579.2020.1801277

IET (2017). Expect the unexpected. Report on the introduction of connected and autonomous vehicles (CAVs). Retrieved on December 3rd, 2021, from: https://www.theiet.org/impact-society/factfiles/transport-factfiles/expect-the-unexpected/

Kapoor, R., & Klueter, T. (2021). Unbundling and managing uncertainty surrounding emerging technologies. *Strategy Science, 6*(1), 62-74. doi: https://doi.org/10.1287/stsc.2020.0118

Kassens-Noor, E., Cai, M., Kotval-Karamchandani, Z., & Decaminada, T. (2021). Autonomous vehicles and mobility for people with special needs. *Transportation Research Part A: Policy and Practice*, 150, 385-397. doi: https://doi.org/10.1016/j.tra.2021.06.014

Kjellberg, H., & Murto, R. (2021). Theorizing markets. *AMS Review, 11*, 207-215. doi: https://doi.org/10.1007/s13162-021-00218-8

Konstantas, D. (2021). From Demonstrator to Public Service: The AVENUE Experience. In: Mira-Bonnardel S., Antonialli F., Attias D. (eds). *The Robomobility Revolution of Urban Public Transport: A Social Sciences Perspective* (107-130). Springer. https://doi.org/10.1007/978-3-030-72976-9_5

KPMG International. (2020). Autonomous Vehicles Readiness Index: Assessing the preparedness of 30 countries and jurisdictions in the race for autonomous vehicles. Retrieved April 19th, 2022, from https://home.kpmg/xx/en/home/insights/2020/06/autonomous-vehicles-readiness-index.html#download

Malhotra, N., Nunan, D., & Birks, D. (2017). *Marketing research: An applied approach* (5th edition). Pearson.

Marletto, G. (2019). Who will drive the transition to self-driving? A socio-technical analysis of the future impact of automated vehicles. *Technological Forecasting and Social Change, 139*, 221-234. doi: https://doi.org/10.1016/j.techfore.2018.10.023

Milakis, D., Van Arem, B., & Van Wee, B. (2017). Policy and society related implications of automated driving: A review of literature and directions for future research. *Journal of Intelligent Transportation Systems, 21*(4), 324-348. doi: https://doi.org/10.1080/15472450.2017.1291351

Nenonen, S., & Storbacka, K. (2021). Market-shaping: navigating multiple theoretical perspectives. *AMS Review, 11*, 336-353. doi: https://doi.org/10.1007/s13162-021-00209-9

Nenonen, S., Storbacka, K., & Windahl, C. (2019). Capabilities for market-shaping: triggering and facilitating increased value creation. *Journal of the Academy of Marketing Science, 47*, 617-639. doi: https://doi.org/10.1007/s11747-019-00643-z

SAE International. (2021). Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles. Retrieved on April 19th from: https://www.sae.org/standards/content/j3016_202104/

Wang, W., Zhou, F., Li, W., & Budd, J. (2018). Designing the Product-Service System for Autonomous Vehicles. *IT Professional, 20*(6), 62-69. doi: https://doi.org/10.1109/MITP.2018.2876924

Wigley, E., & Rose, G. (2020). Who's behind the wheel? Visioning the future users and urban contexts of connected and autonomous vehicle technologies. *Geografiska Annaler: Series B, Human Geography,* 102(2), 155-171. doi: https://doi.org/10.1080/04353684.2020.1747943

Wolmar, C. (2020). *Driverless cars: on a road to nowhere* (revised edition). London Publishing Partnership.