INVESTIGATING FUTURE MOBILITY SCENARIOS WITH AUTONOMOUS VEHICLES THROUGH DESIGN FICTION

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ABSTRACT

INVESTIGATING FUTURE MOBILITY SCENARIOS WITH AUTONOMOUS VEHICLES THROUGH DESIGN FICTION

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Future mobility is an area which requires exploration for both academic and business purposes. Technological developments such as electrified vehicles (EV), sharing services and autonomous vehicles (AV) have started taking their places in the transportation industry. AVs' presence on the roads is expected in near future. There are predictions on how and when AVs are going to be eligible and uncertainties about how AVs will change people's transportation habits and lifestyles. This thesis investigates future mobility and transportation design through the existence of AVs. Hence, the study aims to further investigate this issue using design fiction methodology by creating fictional storyworlds. For this purpose, two design fiction workshops were organized with designers to speculate on a fictional world and then, build design scenarios on this world where AVs would become a part of daily life. The study also provides insights on design fiction methodology by pointing out how designers speculate on the features of AVs within future storyworlds. As a result, the narratives and scenarios created by designers were analyzed and characteristics of the scenarios were identified considering the social and contextual aspects of the storyworlds. Moreover, there were design considerations for AVs stated by participants. Along with that, the workshop format was discussed with regards to

how participants responded to the workshop activities and subsequently, the strategies they adopted were extracted.

Keywords: design fiction, future mobility, autonomous vehicles, design futures, transportation design

ÖZ

OTONOM ARAÇLI GELECEK ULAŞIM SENARYOLARININ KURGUSAL TASARIM İLE İNCELENMESİ

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Yüksek Lisans, Endüstri Ürünleri Tasarımı
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Gelecekteki mobilite, hem akademik hem de ticari açılardan araştırılması gereken bir alandır. Elektrikli araçlar, paylaşım servisleri ve otonom araçlar gibi teknolojik gelişmeler giderek ulaşım sektöründeki yerlerini alırken, otonom araçların kullanımının yakın gelecekte yaygınlaşması beklenmektedir. Öte yandan, otonom araçların nasıl ve ne zaman uygun olacağına dair tahminler yürütülürken, insanların ulaşım alışkanlıklarını ve yaşam tarzını nasıl değiştireceği konusunda belirsizlikler sürmektedir. Bu tez çalışması, otonom araçların varlığı aracılığıyla gelecekteki mobilite ve ulaşım tasarımını araştırmaktadır. Bu nedenle çalışma, kurgusal tasarım yöntemini kullanarak, kurgusal hikaye dünyaları yaratmakta ve böylelikle konuyu daha detaylı irdelemektedir. Bu amaçla, tasarımcılarla kurgusal bir dünya yaratmak ve ardından otonom araçların günlük hayatın bir parçası olacağı bu dünya üzerinde tasarım senaryoları oluşturmak için iki kurgusal tasarım çalıştayı düzenlenmiştir. Çalışma aynı zamanda tasarımcıların gelecekteki hikaye dünyalarında otonom araçların özellikleri hakkında nasıl spekülasyon yaptıklarına işaret ederek kurgusal tasarım yöntem bilimi hakkında fikir vermektedir. Sonuç olarak, tasarımcılar tarafından oluşturulan anlatılar ve senaryolar analiz edilmiş ve hikaye dünyalarının sosyal ve bağlamsal yönleri dikkate alınarak senaryoların özellikleri belirlenmiştir.

Ayrıca, katılımcılar otonom araçlar için tasarım önerileri üretmişlerdir. Bununla birlikte, katılımcıların çalıştaylardaki etkinlikleri nasıl ele aldıkları üzerinden çalıştay formatı tartışılmış ve kullandıkları stratejiler ortaya çıkarılmıştır.

Anahtar Kelimeler: Kurgusal tasarım, gelecekteki mobilite, otonom araçlar, tasarım gelecekleri, ulaşım tasarımı

To creativity, imagination and dreams

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LIST OF ABBREVIATIONS

AV: Autonomous Vehicle

EV: Electrified Vehicle

AI: Artificial Intelligence

AR: Augmented reality

VR: Virtual Reality

CAR: Center for Automotive Research

MaaS: Mobility as a Service

SAV: Shared Autonomous Vehicle

CAV: Connected Autonomous Vehicle

V2X: Vehicle to Everything

V2I: Vehicle to Infrastructure

V2V: Vehicle to Vehicle

UN: United Nations

PDFi: Participatory Design Fiction

UTIs: Urinary Tract Infections

AR/VR: Augmented Reality/ Virtual Reality

W1P1: Workshop 1, Participant 1

SAE: Society of Automotive Engineers in the United States

CHAPTER 1

INTRODUCTION

1.1 Background

Mobility is one of the fastest improving business areas. Even though it might refer to different terms, in this study, it will be considered in the means of transportation. Frequently, mobility is identified with economic power, luxury and individual liberty, and the distinctiveness that these lifestyles create (Zmud, Ecola, Phleps & Feige, 2013). People can transport using a variety of vehicles and preferences of mobile vehicles may vary; there are people who are car enthusiasts, motor bikers or boat fans. Also, technological improvements affect the way people transport since companies are choosing their development strategies based on these. For instance, recently electricity is becoming crucial as a resource for vehicles. Thus, electrified vehicles (EVs) are becoming a part of daily life and e-bikes or e-scooters are often being used. Moreover, they have also started to replace internal combustion engine vehicles. The transportation industry is one of the first industries to integrate the recent innovations into their designs and this causes quick transitions on how mobility is shaped all around the world.

Artificial Intelligence (AI), a system that is able to accurately interpret data and to reflect the knowledge of this data to succeed in other tasks (Kaplan & Haenlein, 2019), is expected to be a primary element of future mobility and with its presence, the human role in mobility is becoming a minority. Also, other innovations like sharing services decrease the time that is directly interacted with the vehicle.

AI features can impact the vehicle, the infrastructure and the user of the vehicle and also the interaction and the services related to these (Miles & Walker, 2006). Designers and engineers produce vehicles to ease drivers' tasks and as a result, the

tasks are gradually taken over by automation. Autonomous Vehicle (AV) is the final result of this process in which the driver is fully replaced by an AI system and automated driving is being represented as one of the technologies that may cause a considerable shift in the transportation industry (Milakis, van Arem & van Wee, 2017).

Most car companies have already started to design their AVs and are getting ready to launch them on the market. For instance, Google started selling their AV in 2018 and Audi A8 was released with "Self-Drive" technology in 2017 (ARUP, 2017). Mobility is predicted to encounter a considerable transformation with the involvement of automated driving (Papa & Ferreira, 2018). Some researchers think positively and demonstrate the positive effects of having AVs like fewer incidents, healthy environments and more mobility opportunities. Thus, this positive assumption relies on the connectivity of these vehicles; Connected Autonomous Vehicles (CAV). This model leads to an idea of a smart city where CAVs and sharing services are used in proper infrastructure (Nikitas, Michalakopoulou, Njoya & Karampatzakis, 2020). On the other side of these optimistic views, there are also potential concerns about having AVs. For example, building trust for these vehicles does not seem easy due to possible security and privacy concerns. Moreover, the high costs of AVs and moral issues are yet to be solved. Thus, there are many uncertainties about how future mobility will involve AVs and these new technologies such as Artificial Intelligence (AI) and sharing service systems. How will they affect the users' experience and social life?

According to Zmud et al. (2013) the current information for envisioning long-term future mobility scenarios are vague, immature or confusing and for that reason, they applied scenario-building techniques. When the issue of future scenarios is observed from a designerly point of view, new visions and new challenges for AVs' presence may occur. Efficient use of an upcoming technology produces a wicked design problem (Darby, Tsekleves & Sawyer, 2018). An approach to such issues is called speculative design in which designers look at the future in a critical manner (Auger, 2013). Speculative design is an umbrella term for such design thinking methods and

by using this approach, designers investigate plausible future scenarios (Darby, Tsekleves & Sawyer, 2018). Design fiction is one of the methods for building future scenarios and it is useful for creating social contexts. The method relies on diegetic prototypes which "demonstrate a technology's need, viability and benevolence" (Kirby, 2010, p.43). Design fiction implies techniques like prototyping, brainstorming and it supports them with different approaches from art, cinema or philosophy; it creates spaces for integrating recent technologies from a societal perspective (Darby, Tsekleves & Sawyer, 2018)

This study adopts design fiction to envisage future mobility focusing on scenarios including AVs. Subsequently, it reflects the context of the scenario by reflecting the cues from the storyworld that it is built on.

1.2 Aim and Research Questions

The aim of this study is to explore the characteristics of design ideas about future AVs. Moreover, it will demonstrate how a fictional approach can guide the process of creating future mobility scenarios.

Design fiction methodology is used to speculate on the design of AVs within future worlds. Thus, workshops with designers were organized allowing them to design scenarios including AVs, based on the below research questions:

- What are the characteristics of potential ideas for the design of future AVs considering the social and contextual changes?
- How can design fiction methodology guide the process of envisioning future transportation?

1.3 Structure of the Thesis

This thesis consists of five chapters and these chapters and their themes are briefly described below.

Chapter 1 is the introduction part. It covers the background of the thesis, its aim and research questions, and the structure.

Chapter 2 is the literature review part. It includes future mobility and innovations, AVs and their effects, future mobility scenarios and design fiction.

Chapter 3 is the methodology part. This chapter mentions data collection methods, recruiting of sampling group, design of workshops, workshop process and data analysis.

Chapter 4 is the findings part. In this chapter, the results of the field study, discussion of the extensive findings, and significant points with the literature review are demonstrated.

Chapter 5 is the conclusion part. This chapter revisits the research questions and answers them; explains the limitations of the study, opportunities for further research, and contributions of the study.

CHAPTER 2

LITERATURE REVIEW

2.1 Future Mobility

The term “mobility” engages various departments such as regional design, engineering and social sciences. Actually, mobility and transportation are two different terms that describe similar concepts. According to the Center for Automotive Research (CAR, 2016), transportation is a system-based definition while mobility is a user-based definition. Recent developments such as sharing services and connectivity caused a shift in the language based on the understanding of transportation and the term mobility replaced it (CAR, 2016). Indeed, technological innovations have a direct impact on how mobility is shaped all around the world. Designers and engineers produce vehicles to ease the drivers’ tasks and as a result of this, the drivers’ tasks are decreasing in number. Most car companies have already started to design their Autonomous Vehicles (AVs) and are getting ready to launch them on the market. According to Coppola and Silvestri (2019), vehicle automation is depicted as one of the primary objectives of the current transportation industry.. However, there are many uncertainties about how future mobility will involve new products such as AVs and systems such as sharing services.

2.1.1 Innovations on Mobility

Coppola and Silvestri (2019) sorted mobility technologies into four groups: electrification, connectivity, innovative mobility services and automation. In this study, innovative mobility services are discussed under Section 2.1.1.1 Service-

Based Innovations; electrification, connectivity and automation are discussed in Section 2.1.1.2 Vehicle-Based Innovations. Since 2011, electricity has been widely used as an alternative energy resource in the industry and it is expected to replace fuel energy within the next few years (Coppola & Silvestri, 2019). Innovative mobility services such as vehicle-sharing, ride-hailing an ride-sharing are currently in use. In contrast, Mobility as a Service has just begun to be a part of the passengers' journeys and Autonomous Mobility on Demand is yet to come within the next few years (Figure 2.1). Connectivity-based vehicle technologies will have an essential place for the future of transportation when they are combined with autonomy and sharing.

These terms are explained below:

- Vehicle-sharing: Vehicle-sharing systems provide a vehicle or a bike for a defined time interval.

- Ride-hailing: Ride-hailing allows the user that asks to travel to a defined location, matching with another user that can take him/her with a private vehicle (Tirachini, 2019).

- Ride-sharing: Ride-sharing allows users to share a vehicle during travels that are passing close or similar locations (Alonso-Mora, Wallar & Rus; 2017).

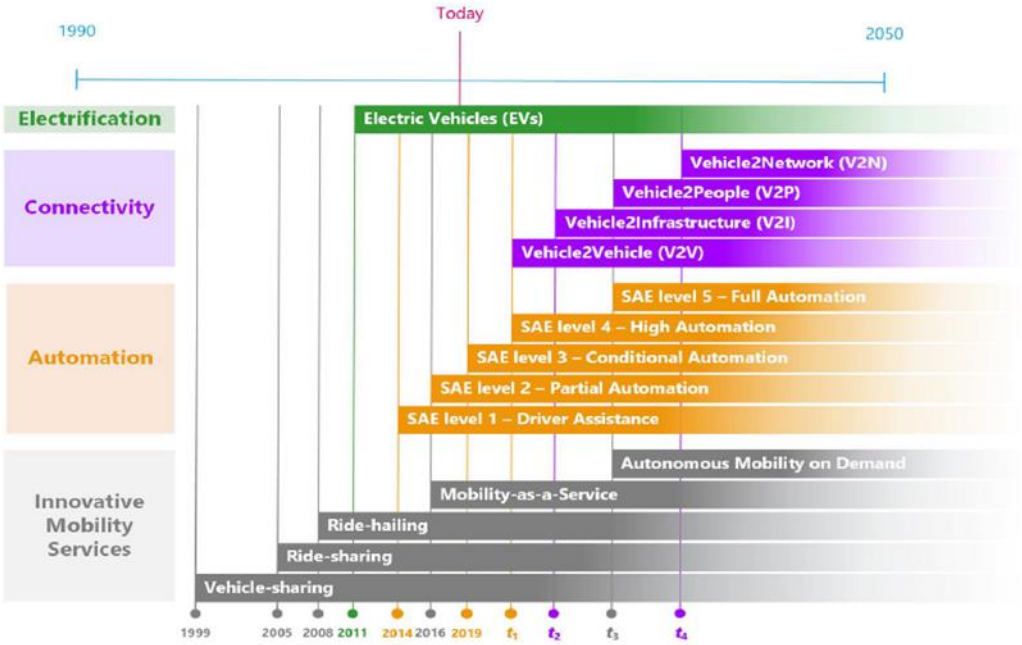

Figure 2.1 Timeline for the improvement of future mobility (Coppola & Silvestri, 2019, p.12).

Automation is one of the most exciting innovations within the transportation industry and Artificial Intelligence (AI) is the main technology behind the idea of this innovation. Even now, AI is used to develop vehicle features such as park sensors and traffic monitoring apps. These entities create the big data, which is the principal starting point for using AI in the mobility sector, letting machines run themselves instead of humans such as for driving (Coppola & Silvestri, 2019).

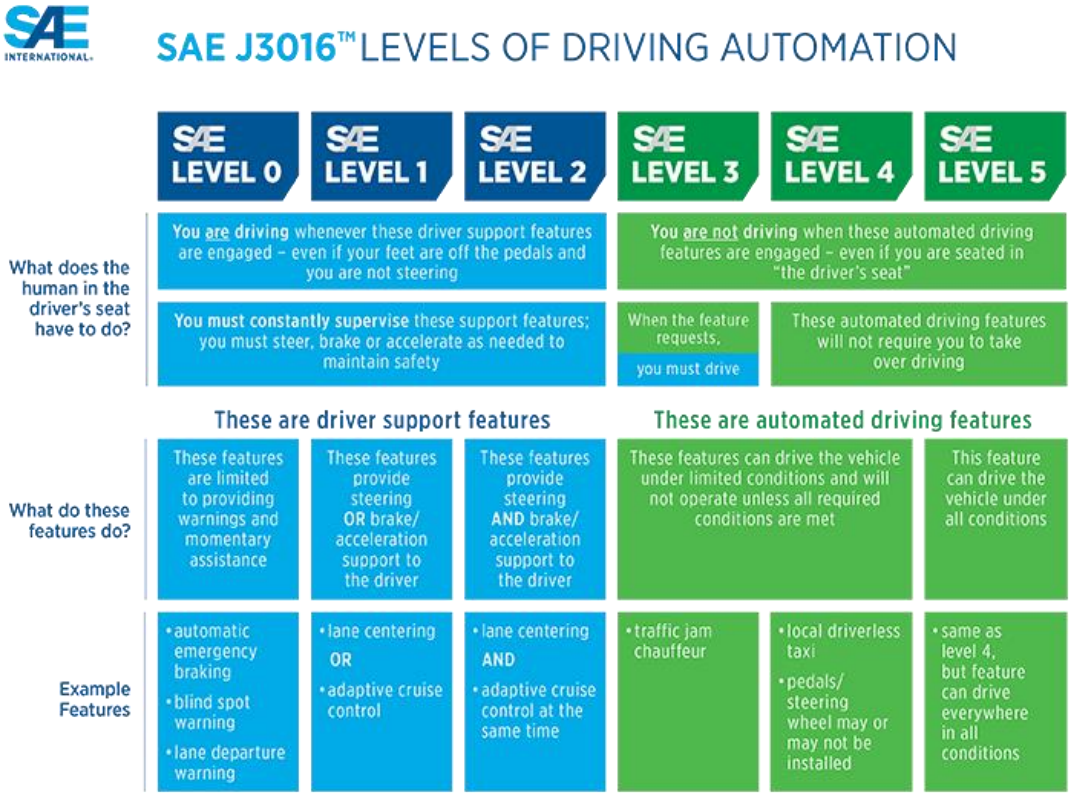

Figure 2.2 (SAE: Levels of Autonomy, 2021)
(https://www.sae.org/standards/content/j3016_201806/)

Based on the automation levels that are shown (Figure 2.2), the vehicles that have Level 0, 1 and 2 can be encountered on the roads in 2021. With Level 3 of automation, the vehicle starts to drive itself with no help under specific circumstances. Level 5 signifies that the vehicle can be driven all by itself in all conditions.

According to Transport Systems Catapult (2017), which is a governmental transportation society in the UK, most automotive industries are planning to advertise fully Connected Autonomous Vehicles (CAV) by the year 2030. Car companies state that fully automated vehicles, called Level 5 autonomy by the Society of Automotive Engineers in the United States (SAE) (Figure 2.2), are going to be on the roads within the next ten years (CAR, 2016).

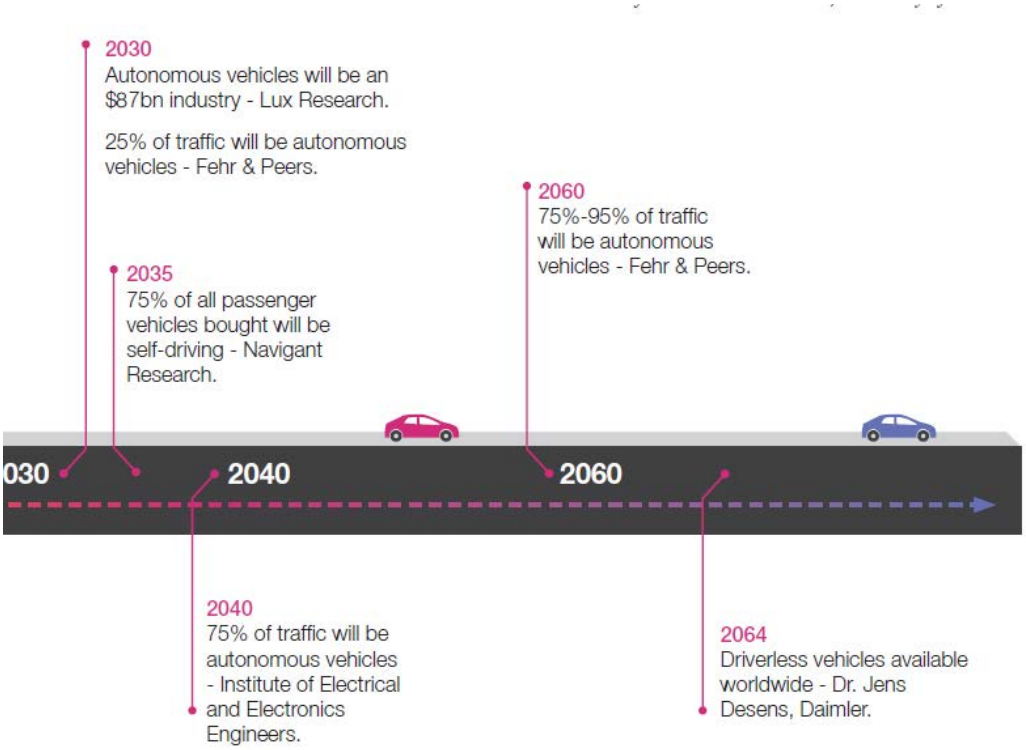

Figure 2.3 ARUP's prediction of future mobility improvements on a timeline (ARUP, 2017)

ARUP, which is a British multinational professional services firm headquartered in London (2017), has graphically represented how the possible improvements on AVs are going to be. They assume that by 2025, 25% of the vehicles that are in traffic are expected to be AVs and this percentage increases to 75% in 2035 and it will reach its full condition by 2064. As the number of years increases, the predictions get fuzzy. However, this representation creates a general perspective (Figure 1.3). According to Litman (2017), half of the new vehicles are going to be AVs around 2045, and a future where nearly all vehicles might be around 2060.

2.1.1.1 Service-Based Innovations

Mobility services have already started to be a part of daily travels. As the mobility technologies improve, the services are adapting to these new technologies as well. Figure 2.1 shows vehicle-sharing, ride-sharing, ride-hailing and mobility as a

service which are currently active. When the roads meet with AVs, Autonomous Mobility on Demand is yet to come.

Sharing Services and Mobility as a Service (MaaS)

According to Krueger, Rashidi and Rose (2016), with the arrival of autonomous technologies, it might be possible to have shared autonomous vehicles (SAVs) which may create opportunities for cheaper transportation. Hence, Krueger et al. (2016) supported that it might be beneficial for the sustainability of mobility systems if they can offer on-demand services and door to door facilitations. On-demand services are accessible or schedulable on a defined track depending on users' wish and door to door facilitations can create a smooth mobility service that has no issue for the user in any step (Coppola & Silvestri, 2019). Furthermore, as the usage rate of sharing services and public transportation increases the need to have a personal vehicle may decrease (Fagnant, Kockelman & Bansal, 2015). Thus, there also exists a competitiveness between transportation services and automotive companies. Some of the companies have already started to own or set a mobility service as a part of the company such as *Car2Go* by *Daimler* or *DriveNow* by *BMW* (Coppola & Silvestri, 2019). In addition, Ford and Volkswagen declared that they are planning on creating new mobility services (CAR, 2016). As the sharing services begin to improve a new definition comes up: Mobility as a Service (MaaS).

MaaS has become popular around 2016 via the Finnish start-up MaaS Global and it has been a revolutionary attempt that started in Europe and spreaded to the world (Coppola & Silvestri, 2019). MaaS is an emerging concept and the main idea it reflects is creating an integration of innovative services and public transportation to build a door-to-door service concept through digital interactions. Holmberg, Collado, Sarasini and Williander (2016) state that the term MaaS still has ambiguities as it is still transitioning. For instance, *Uber*'s journey as a service can be considered as MaaS. *Uber* was founded as a peer-to-peer taxi service, around 2015 added some carpooling features as well as integration with public transportation. Thus, since their

service system has started to cover a more extensive user experience which can be exemplified as MaaS (Holmberg, Collado, Sarasini & Williander, 2016).

ARUP (2017) depicts a scheme representing the stakeholders' activity in MaaS (Figure 2.4). The customer is in the center and he/she can access all connected data through the MaaS operator. The main purpose of the system is to enable the customer to receive satisfactory feedback. This scheme shows an expanded definition of MaaS and it is dependent on the data sharing and connectivity of all stakeholders. Personalized services part shows that a sharing service also can be personalized even though in some situations the vehicle may not be.

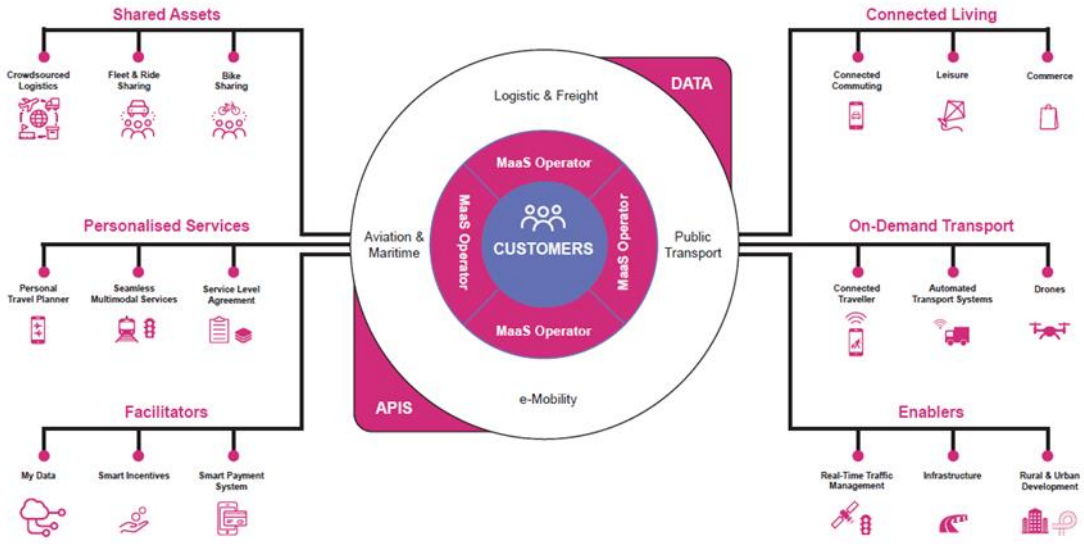

Figure 2.4 MaaS System Map (ARUP, 2017)

As formerly mentioned, Uber's development seems to be a pioneer for MaaS. Uber was founded as a serving-limo, became a taxi-like product, moved forward into car-sharing and currently, it is a public transportation option (Holmberg et al, 2016). Moreover, the model created by Holmberg et al. (2016) represents the owned vehicle's involvement in the MaaS system but it also shows how other

mobility systems can integrate into each other (Figure 2.5). The X-axis represents ownership, while sharing and integration is represented by Y-axis. It describes briefly how the MaaS concept can be flexible by including owned vehicles. The vehicle/s may be owned by a person or a company. The dotted line represents the change from simplified ownership, in which no sharing services or public transport exists, to combined mobility services, in which private or public every vehicle is enabled to work with sharing services.

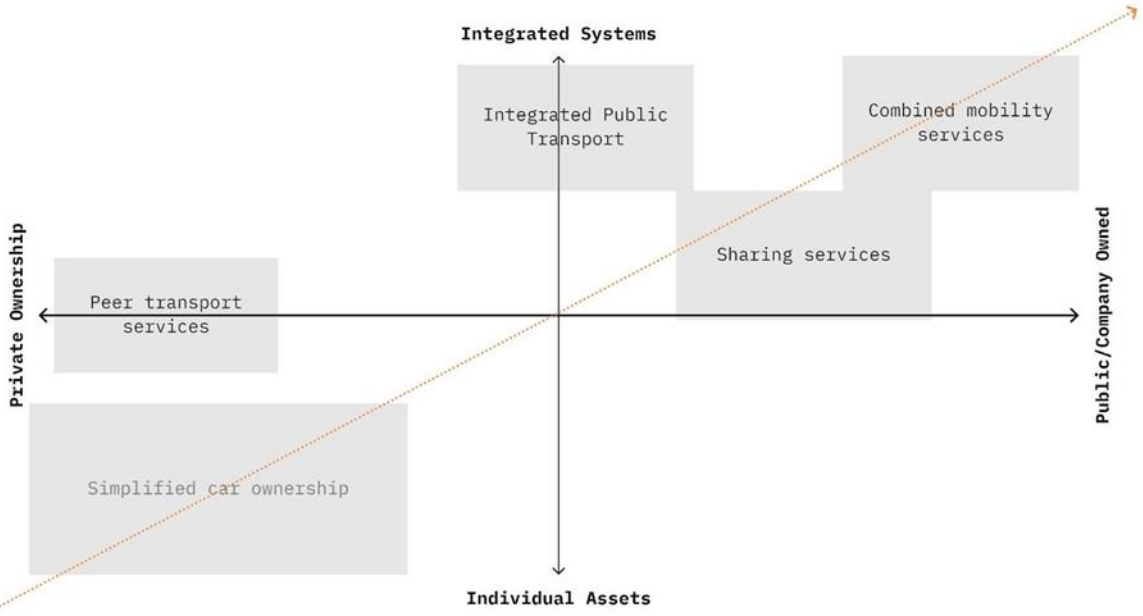

Figure 2.5 Model for Integration of MaaS to private and public transportation (adapted from Holmberg, Collado, Sarasini & Williander, 2015, p.24)

2.1.1.2 Vehicle-Based Innovations

As it was mentioned in Section 2.1.1, according to Coppola and Silvestri (2019) future technologies can be categorized in four areas: service innovations, electrification, connectivity and automation. In the last section, service-based

innovations are described and the literature review will continue with vehicle-based innovations. First is *electrification* which has already started to be used in public. As for *connectivity*, even though it is a developed technology, its use does not spread around the world yet, and automation still has a lot of barriers to pass (Coppola & Silvestri, 2019).

Electrification

Electrification of vehicles has already begun and it is spreading rapidly all around the world. According to Coppola and Silvestri (2019), there are two main reasons behind this expansion:

- More affordable prices of Electrified Vehicles (EV) compared to the fuel-powered ones
- Legislations set by governments due to environmental reasons

Furthermore, there are still issues to overcome for EVs to dominate globally, such as short batteries, lengthy recharging processes and infrastructural problems. Thus, it can be said that the transition to EVs is not going to happen in the short term since there is an obvious need for cities to transform their infrastructure and regional planning. Fulton, Mason and Meroux (2017) mention the significance of insufficient driving range as a barrier standing against EVs' rise. Moreover, these barriers improve the cost of vehicles as well. Hence, Fulton, Mason and Meroux (2017) state that EVs' rise is more likely with the assistance of the governments through EV supporting behaviors.

Connectivity

Connectivity of systems or products is a rising innovation and *Connected Vehicles* (CVs) are going to be an important aspect of future mobility. Coppola and Silvestri (2019) describe CVs as the vehicles that have superior communicative features

which enable information transfer, using diverse media. The term Vehicle-to-Everything (V2X) is used to define all these capabilities. Terms can be summarized below according to ARUP (2017);

- Vehicle-to-Vehicle (V2V): Vehicles can share information about mobility with each other.
- Vehicle-to-Infrastructure (V2I): Vehicles and infrastructures such as radar, traffic lights can exchange information with each other.
- Vehicle-to-Everything (V2X): Vehicles can contact infrastructures, other vehicles and other public actors on the traffic like pedestrians.

Infrastructure is an important part of future mobility that provides connectivity since all these new features depend on a new regional plan, which might be included in a smart city. Physical infrastructure such as bridges and roads should be considered as well as digital infrastructure. ARUP (2017) states some possible novelties on the infrastructure of the cities considering electrification, autonomy and connectivity:

- The lanes can be narrower since the connected cars can move closer and calculate the spaces themselves.
- Integrating the design of connected charging points repeating at proper distances around the city.
- All the signs and barriers have been designed for human drivers. New design of physical and digital signs should be reconsidered.

AVs' integration is related to the innovations explained; sharing, electrification and connectivity. These innovations are expected to dominate the transportation industry together. However, as it was demonstrated in Figure 2.1 (Coppola and Silvestri, 2019) automation is the last step of them. Since, vehicle automation is fundamental to this study it will be discussed separately in Section 2.1.2.

2.1.2 Vehicle Automation

In the previous sections, technological enhancements were described as the steps to automation. It is meaningful to see how all these improvements affect the other things around to create a larger perspective for automated driving. Milakis, van Arem and van Wee (2017) visualized the global effects of automation with a visual: Ripple Effect of Automated Driving (Figure 2.6). It is a detailed map that shows how vehicle automation affects different areas. Even though it is not able to fully cover every area in detail, it reflects the general perspective. Self-driving is placed in the center and there are three ripples that are meant to show that effects reduce going from the center to the outer ripples. The first layer consists of short-term effects; travel conditions and traffic occasions. Thus, one of the most affected areas are vehicle use, public transportation, cost of vehicles, capacity and congestion. The second layer includes infrastructural changes and vehicular conditions like vehicle ownership, parking, roads and employment. The last layer shows the long term effects focusing on social effects like health, economy and social equity.

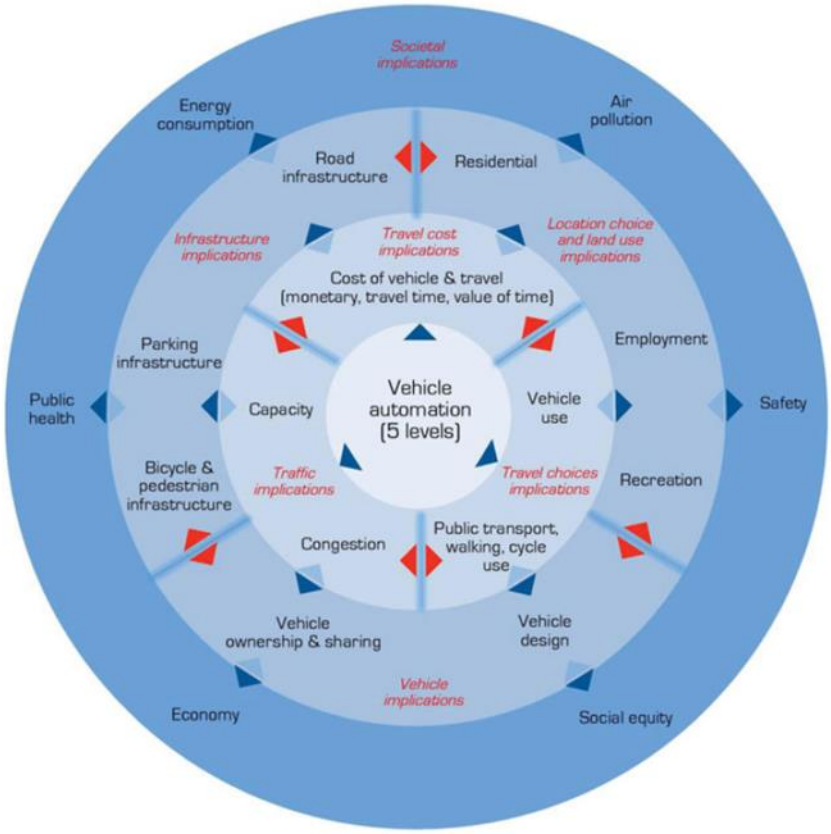

Figure 2.6 Ripple Effect of Automated Driving (Milakis, van Arem & van Wee, 2017, p. 326)

As an addition to Figure 2.6, Litman (2017) lists possible pros and cons of having AVs on the road. One of the most appreciated impacts of AVs is their capacity for travelers to spend time efficiently during travels and their possibility to create new travel opportunities for the people who cannot drive. However, many problems can emerge with the involvement of AVs in human life; safety and trust are the prominent ones.

Demographic Trends	User Preferences
• Population age structure • Population growth and density • Licensed drivers	• Social preferences for mobility • Preferences for residence • Telework and work commute
Transportation Options	**Transportation Costs**
• Available means of transportation: private vehicle, mass transit, ridehailing, taxi, carsharing, car rental, ridesharing, carpooling, bicycle, bikesharing, walking	• Fuel prices, transit fares • Vehicle ownership costs • Toll and parking prices • Road congestion
Infrastructure and Planning	**Macrofactors**
• Land zoning and development trends • Public investment • Traffic management systems	• Economic growth • Employment and income • Global warming and pollution

Figure 2.7 Key Factors Affecting Travel Behavior (CAR, 2016, p.8)

With all the improvements that were demonstrated till this part, it seems like the future mobility is going to show its effect in different scales. In terms of design, it will affect all stakeholders from system design to interaction design. CAR (2016) defines the interaction during travels as travel behavior; describes the key factors that are affecting the travel behavior within the context of future mobility (Figure 2.7). Demographic trends may affect AVs in terms of creating new mobility opportunities for unlicensed users. Thus, the users can create new social opportunities. All the transportation options and cost can be drastically affected by AVs; and these options may need new definitions. Infrastructure is crucial considering the connectivity's effectivity in smart cities, it will help controlling the traffic and parking. These factors are valuable for the study since the possible outcomes may be related to social, economic and regional issues.

2.1.2.1 User

Technological and legal issues are not the only problems that stand against AVs, the side of users should also be considered. It will not be easy for users to adapt to living with AVs in the first stage. Moreover, acknowledgment of AVs by the community is a very crucial step for AVs' existence (Hengstler, Enkel & Duelli,

2015). Litman (2017) states that the effect of AVs to total vehicle travel is a critical issue. They may multiply total vehicle travel by;

- creating an independent mobility opportunity for non-driving users,
- creating an efficient and comfortable journey,
- decreasing operational costs, and
- promoting longer journey durations through the existence of more horizontally settled regions.

On the other hand, they can boost vehicle sharing and this may reduce the number of people who own a vehicle and hence, travel with vehicles as well. AVs' possible benefits for society can be observed if there are sufficient autonomous systems operating on the roads. For example, less carbon emission and traffic congestion, simpler road design and narrower lane widths can be considered when there is an autonomous transportation system.

It was mentioned by Litman (2017) that the traveler user groups may expand as AVs spread around the world. Also, it should be considered that the world's population may look a bit different when AVs will be on the roads. AVs are going to impact the elderly in terms of independent mobility and United Nations (UN, 2017) predicts that in 2050 the number of people who are at the age of sixty or older is going to double. For Europe, it is going to be %35 of the population which is now %25. Thus, even though AVs give elderly a possibility of mobile freedom, adopting such a technology can be challenging for these people.

Although AVs have many benefits to increase the quality of life, one of the most arising questions is how society will grasp these vehicles in traffic. Some challenges that AVs' improvement can encounter stated by Chan (2017) are:

- Expected high costs of advertised AVs,
- Giving up the driving activity to a machine for drivers, and

- Needing a vast transformation in legislations and real-life practices.

Additionally, Grush, Niles and Baum (2016) state that AVs can create new psychological problems such as “access anxiety” which can occur when AVs malfunction or delay. Thus, AV journeys may not be easy to adapt both physically and mentally for users.

As it was stated during the Sharing Services (Chapter 2.1.1.1), vehicle automation and sharing services had been planned to operate together. However, this adaptation may encounter different challenges. Litman (2017) mentions that shared travels may create socially awkward situations and pick-up and drop-off actions may cause detention. Furthermore, many users may prefer to own a vehicle since they

- enjoy using it as a storage space and looking after them,
- rely on the vehicles’ use in emergency cases, and
- want to demonstrate their vehicle to the public as vehicles indicate status.

Litman (2017) classified the possible effects of AVs on travels through personas (Table 2.1). The first type of user is a person who is unable to drive such as the elderly, children or the disabled; with the involvement of AVs in daily life, these people can travel independently. The second is a frequent traveler who can enjoy the decreased costs of sharing services. The third is a couple who live in a rural area; since AVs make longer travels quickly established they might have fewer problems caused by living in an area away from the city center. Fourth is a high-risk driver, a drunk or tired driver who is unable to perform the driving activity for a temporary time interval can also use AVs for a less-risky journey. Trommer et al. (2016) add long-mile travelers to these user groups depending on their need to spend time efficiently, so especially those whose work-home distances are long or who encounter traffic congestion often may benefit from AVs.

Table 2.1 *Effects of AVs on user groups explained through personas (Litman, 2017, p.22)*

	User Benefits	Travel Impacts	External Costs
Jake (affluent and visually impaired)	Independent mobility for non-drivers	Increased vehicle travel and external costs	Increased residential parking and roadway costs
Bonnie (multi-modal traveler)	Vehicle cost savings	Reduced vehicle ownership and travel	Reduced residential parking and roadway costs
Melisa and Johnny (suburban family)	Better home location options	Increased vehicle ownership and travel	Increased residential parking and roadway costs
Garry (high-risk driver)	Avoids driving drunk and associated risks	Less high-risk driving, more total vehicle travel	Increased residential parking and roadway costs

2.1.2.2 Trust

Trust is an important asset that stands against many AI-based innovations' acceptance processes (Choi & Ji, 2015). According to Rempel, Holmes and Zanna (1985) trust in automation processes around three steps: predictability, dependability, and faith. Trust's primary driver during the initial processes is predictability of the actor, which can be described as the assumability of consequent action. As the time passes trust is started to be driven by dependability, which can be expressed as coherency of performed actions. Finally, if everything goes as planned faith exists. According to Lee and See (2004), there are three aspects that are significant for trust in automation: performance, process, and purpose. Performance can be defined through users' evaluation of product, process can be determined as users' judgment of systems operation, and purpose can be described as objective of the system. All of these three aspects should be combined for a proper building of trust. Muir and Noray (1996) state that users tend to trust automated agents as perceived reliability increases. Moreover, Choi and Ji (2015) explain this under the term system transparency; the level at which the user can anticipate and figure out the actions of AVs. Trust may decrease in the case of an error. However, description of errors might keep up the trust between user and product (Dzindolet, Peterson & Pomranky, 2003). Moreover, when the operator has

the opportunity to handle the errors, trust is reinforced (Muir & Noray, 1996). Trust between users and automated agents tends to gain strength in the process of time unless there is a serious error (Lee & See, 2004).

The user's relationship with the vehicle is questionable due to the ambiguity of who owns the driver role. If it is a Level 5 autonomy, the interaction design may focus on how users spend time during the journey, excluding the driver role. In such a situation the issue of trust comes to the front. Rödel, Stadler, Meschtscherjakov and Tscheligi (2014) also state that the handling of the trust issue becomes more difficult as the autonomy level of the vehicle rises. The vehicle also should improve a relationship in which it can learn the goals and expectations of users, and understand and perform according to users' needs.

Anthropomorphism

Duffy (2003) declares that anthropomorphism has a potential to be used for robot design. Users consider anthropomorphic approaches to products when there is no previous experience with the systems (Li, Hess, & Valacich, 2008). Verberne, Ham and Midden (2015) state that trust increases if the AVs' virtual driver behaves and appears similar to humans. Kiesler and Goetz (2002) mention that anthropomorphism's most important element is not the humanly look. However, Kraus, Althoff , Heißing and Buss (2009) argue that demonstrating information processes to users increases system transparency. AV was given human characteristics such as name, gender and voice in Waytz, Heafner and Epley's study (2014) and they found out that participants thought the vehicle having anthropomorphic aspects were trusted more. Thus, visualizing information through anthropomorphism may affect users' trust in a positive way, which enables more opportunities for acknowledgement of AVs (Lee, Kim, Lee, & Shin, 2015). Anthropomorphism might create issues like uncanny valley (acDorman, & Kageki, 2012). Accordingly, if anthropomorphic features reach the level of having

attributes that are too close to a human, then this creates a negative effect on the user (Niu, Terken & Eggen, 2018).

2.1.2.3 Safety

Safety is going to be a vital asset for the engagement of AVs, and it is an issue related to the technological improvements and the trust that is built between user and vehicle. Litman (2017) listed possible safety problems that can be encountered during the usage of AVs:

- Hardware and software errors
- Bad-natured hacking
- Over trusting technology of other actors
- Increased total vehicle travel
- Decreased assets for conventional safety planning

Chan (2017) states that AVs will create a decrease in the number of incidents and this will cause an economical plus for AVs against society since it will also reduce the number of injuries and death. However, Tafidis, Farah, Brijs and Pirdavani (2021) declares that there are uncertainties about how AVs and unsafe stakeholders of the streets interact. Moreover, expected benefits of AVs are not exactly proven and it can also be speculated that different types of incidents may occur, considering the system errors, infrastructural problems etc. According to Sivak and Schoettle (2015), AVs are not proven to perform a safer journey than a competent driver. If there will be a time when AVs and human drivers perform on the same road, in that case travels can even become less safe; especially for human drivers. Therefore, Smith (2016) created a framework where system and human driver both engage as drivers, the human driver is set to be the main driver in critical situations such as complicated maneuvers, contravention of traffic etc. According to Tafidis et al. (2021) safety is a significant issue for AV developers, and safety tests are crucial. From a designerly point of view, there is a need for new infrastructural element settings like pavement designs and signage systems since the meaning of

the road can be different for AVs. For example, signage system can be redefined to direct AVs primarily by adding sensors.

2.1.2.4 Interaction Design

Another area that will be affected by the automation of vehicles is the interaction design of the vehicles themselves and the systems which are linked to them. According to MacVaugh and Schiavone (2010) even though the marketing-based view suspects utility as the primary aspect of acceptance, social-based views describe acceptance and refusal and resistance with respect to the interaction of product and its communal placement. As the vehicles' autonomy increases there will be an obvious change in the interaction design. Moreover, CAR (2016) states that as the new mobility services spread it is going to decrease vehicle sales since car ownership gets less effective. Thus, interaction design between the user and the vehicle will become more significant. The interaction design of an AV can easily be related to the connectivity principles as well. The vehicle needs to interact with other things, which are described as V2V (vehicle to vehicle), V2I (vehicle to infrastructure), V2X (vehicle to everything), taking the place of a human driver. Even though the driver disappears, the pedestrians or other drivers inside other vehicles will still exist. Rakotonirainy et al. (2014) mention drivers' actions such as gestures, glances and flashing lights as examples of communication between vehicles. Also the same can be thought between pedestrians and drivers. Therefore, the exterior interaction of AVs should be considered as significant as the interior interaction. The interior is supposed to become something close to a house room that could be personalized.

Pettersson and Karlsson (2015) conducted a study to define some base points for AV interaction design. In their workshop, the participants selected a car type and a city to work on it. They depicted the landscape and vehicle scale of the situation. In the next step of the study participants had a journey with a vehicle depicted as

autonomous. The results of the study will be discussed by demonstrating some key points:

- Trusting AVs: The trust issue depends on the autonomy level of the vehicle.
- Users' role: Depending on the autonomy level of the vehicle the user's role may change. If the vehicle is fully autonomous the user becomes a passenger. However, if the vehicle is partially autonomous the user might become a driver in some situations, which can be described as the user is a co-driver.
- Societal indications of AV: Participants in Petterson and Karlsson's study believe that travels can be spent more effectively when they have AVs in daily life.
- Interior interaction and metamorphosis: Participants expected the interior of AV to be an "extended living room". Another expectation was the capability of transformation that interior design ought to have which is also explained as futuristic design by some participants.

Through the analysis of this study, some variables that may directly affect the AV experience can be extracted. About societal indications of AV, it also depends again on the ownership issue of AVs but also the function of AVs within cities. If it is assumed that AVs are a way of public transportation, then the user should also consider sharing the journey with others. However, if it is a more superior alternative to a taxi-private vehicle, the vehicle will be a private place for the user.

Kim et al. (2020) conducted a study whose main goal was providing guidelines for the service and UX design of the autonomous taxi. They compared the main differences of a taxi with a driver and driverless taxi through service flow diagrams. They also defined the main steps of user experience through a customer journey map. They separated the journey into four steps: call, pick-up, travel and drop-off and tested them with real users. Participants have experienced the journey with a demo vehicle via the use of the Wizard of Oz method. They found out pain

points through a real scenario. The problems that happened during the journey were:

- The flexibility of location: Even if the user comes to the vehicle with a specific location it may not be exact or change during the journey. Another consideration would be AV's capacity to handle emergent occasions such as health problems, vehicle-based issues etc.
- Providing a free and personal space: Since the user is alone he needs a private space that enables him/her to spend an enjoyable time.

When two studies are compared, first one uses a wide range of methodology of participatory design such as interactive interviews and user enactments; the latter uses enactment with a specific scenario and context to get feedback from participants.

In the first study performed by Pettersson and Karlsson (2015), there were two studies named as A and B. Study A is supposed to be a classic participatory design where the participants use drawing, collaging and narrating expectations of both autonomous vehicles and future urban improvements based on the improvements. In Study B, the user enactment method is applied with a rough AV prototype. Study A worked well to get implications about AV and its effects on daily life and personal views while Study B was better in getting detailed feedback about the interaction with AV.

2.1.3 Discussion on Future Mobility Literature

Analyzing the cumulative information that is conveyed in the literature review, factors of AV design are mapped (Figure 2.8). There are three main drivers of AV design for system and product level:

- Mode of transportation (air, ground, adaptable for both)

- Autonomy level (full-partly)
- Transportation vehicle (public-private)

Autonomy level of the vehicle refers to the self-control of the vehicle which is determined by SAE as between Levels 3, 4 and 5. For that study it is enough to sort them as full autonomy; Level 5, and partly autonomy, Level 3 or 4. This affects the user's role since full autonomy does not require driving skill of AV while other levels of automation require a driving skill from the user in necessary situations. This situation affects the design of vehicles as well. Partly autonomous vehicles should be designed in a way to allow users to perform driving capabilities and at the same time it still should be a living room. Fully autonomous vehicles do not need driving equipment for users.

Mode of transportation refers to the different ways of mobility between two location points. In the related literature, AVs are referred to moving on the ground, on air or both. Transportation mode may directly affect the design of AVs, thus it can be a helpful categorization for the field work.

Transportation vehicles can be categorized in two groups: private and public vehicles. Private travels can be defined through the ownership of the vehicle. AVs are able to create private travels using the sharing services. However, this may affect the interaction design of used spaces. When the vehicle is owned, the interior of the AV becomes a personalizable living area. On the other hand, a shared vehicle's space can be defined as a temporary living room.

All these factors are related to infrastructure as well. Thus, it seems more possible to adapt AVs to smaller locations since infrastructural changes might be costly and take long times. It makes sense to apply pilot AVs in specific regions. These trials may demonstrate how to deal with them on larger scales.

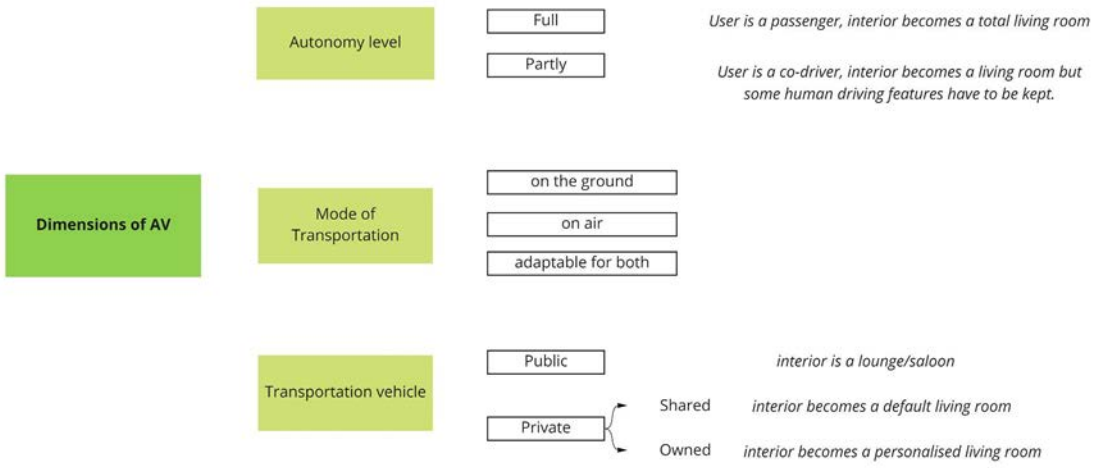

Figure 2.8 Dimensions of AVs

2.2 Future Mobility Scenarios

This section will discuss future mobility scenarios in the literature and predictions about how AVs may spread around the world.

2.2.1 General View on AVs' Spread Around the World

There are some arguments on how future mobility is going to be shaped around the world with all the innovations growing rapidly. According to predictions on future mobility, there seem to be two main paths for AVs to spread worldwide. According to Chan (2017), the *evolutionary path* to AVs' deployment has a progressive improvement while the *revolutionary path* has a breaking point where AVs spread more around the world. Chan (2017) also states it is possible that the world can follow both paths interchangeably (Figure 2.9). His idea seems considerable since

the human population never has simultaneous changes everywhere. Mostly something novel spreads around the world and the adaptation times differ a lot.

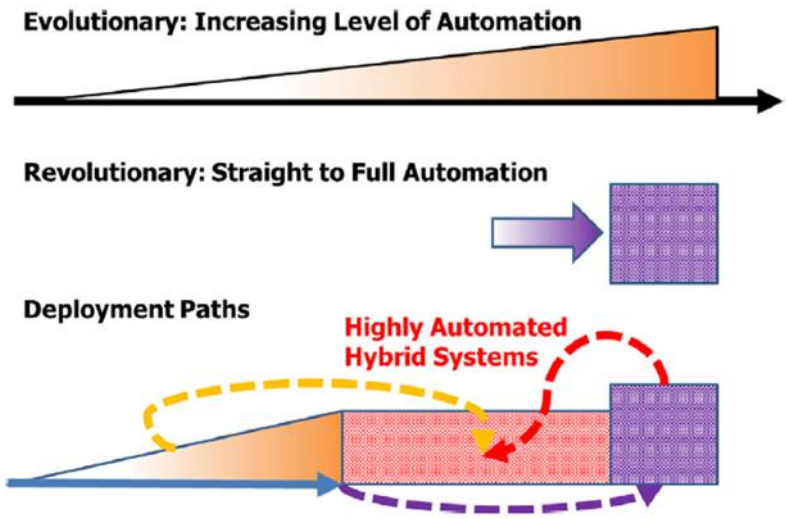

Figure 2.9 Deployment Paths for AV (Chan, 2017, p.211)

There are also definitions based on the driving options of AVs such as *something everywhere* and *everything somewhere* views. According to Chan (2017), something everywhere view supports the idea of active human drivers in necessary situations. Thus, AVs can work everywhere around the world but with limited features (Figure 2.10). The view supports that human drivers can connect via gestures or visual glances in situations that may not be envisioned by AVs themselves. As an addition, there are drivers out there who love driving and they are afraid of AVs' replacing their enjoyment. On the other hand, Chan (2017) declares that, everything somewhere view defends the practical impossibility of enabling both human drivers and AV's AI to work together. The view supports that after a long period of AVs' existence, the human drivers may not be trusted as drivers. Therefore, in this view vehicles are capable of performing all driving activities autonomously but in limited regions. To sum up the latter, AVs are not going to exist everywhere in the world. However, some regions are going to be fully automated. Considering all of these, if "something everywhere" is the path the

world will follow, it may be resulted as encountering sharp differences in mobility level of cities. Tafidis et al. (2021) state that everything somewhere is related to preparedness of infrastructure while something everywhere is related to financial success of AVs. Even though there are rapid technological improvements for AVs' success on the roads, the infrastructure should always allow AVs to function properly, especially for everything somewhere in which fully autonomous vehicles are on the streets.

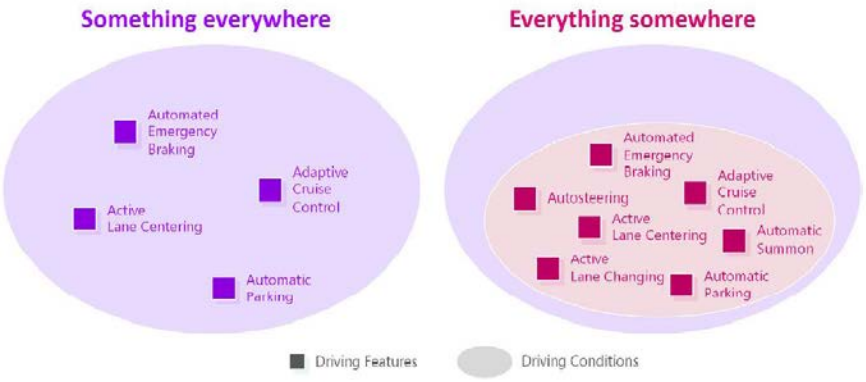

Figure 2.10 Something Everywhere and Everything Somewhere (Coppola & Silvestri, 2019, p.7)

2.2.2 Studies on Future Mobility Scenarios Including AVs

There are several scenario-based studies about future mobility and AVs' integration into civil life. Fulton, Mason and Meroux (2017) based their study on three revolutions (3R): electricity, automation, sharing that could shape the future mobility. They depict three different scenarios for the mobility of the year 2050.

● Business-as-usual (BAU): No significant changes in mobility exist in this scenario. It is a default scenario to create a ground-level for comparison.

● 2R Scenario: The two revolutions are electrification and automation. This scenario does not have shared mobility and it is dominated by private car ownership.

● 3R Scenario: Electrification, automation and shared mobility are active in this scenario.

Comparing these three possibilities Fulton, Mason and Meroux (2017) state the 3R Scenario as the best option. 3R Scenario reduces the traffic, CO^2 emissions and energy use; electrification decreases CO^2 emission, shared mobility decreases energy use and traffic. They also mention the rise in cycling, walking and public transport usage with the addition of shared mobility.

Another future mobility scenario study is by Townsend (2014) which wraps up four alternative scenarios of future transportation (Table 2.2). Each scenario is defined in a different year and in a different city. Future mobility scenarios are named as Growth, Collapse, Constraint and Transformation. Townsend applied the parameters of each scenario to an American city or state to project what the future could look like.

- Growth Scenario (Atlanta-2028): Expected growth continues in areas like finance, science, technology, education etc., and with the decrease in traffic congestion the world cities become more horizontally-settled. Solar energy is the primary energy source for electrified vehicles which perform on autonomous highways.
- Collapse scenario (Los Angeles-2030): In this scenario, positive circumstances fall apart. Low-cost AVs construct a considerable amount of all car traffic. Legislations for vehicles are not fully performed by citizens. There are aggressive and passive AVs on roads and some car-owners do not park but let their cars curve around the city, aggravating the traffic jam.
- Constraint scenario (New Jersey-2029): The constraint in this scenario is a resource. It is the barrier for upcoming innovative actions. Environmental barriers block the horizontal expandability of the city. Citizens dwell in

small and crowded places and use autonomous buses. The city mobility takes the model of transit-oriented development. They try to create some spaces out of parking lots by banning cars.

- Transformation scenario (Boston-2032); Boston uses all the gifts of technology. The city has a huge population of students that dwell in the mini modular flats. Shopping is done through digital walls and the storage is done out of the city. The logistics of goods are done at night by AVs. The city has a very dynamic structure.

Table 2.2 *Four future mobility scenarios (Townsend, 2014, p.10)*

SCENARIO HIGHLIGHTS

Key Characteristics

	Growth	Collapse	Constraint	Transformation
Description	A future in which current conditions persist. Also known as PTE, or "present trends extended".	A future in which some conditions deteriorate from present favorable levels, and some critical systems fail.	A future in which we encounter resource-based limits to GROWTH. A sustainability regime emerges, slowing previous growth.	A future of disruptive change, enabling the transition to an innovation-based regime of even more rapid GROWTH.
Setting	Atlanta 2028	Los Angeles 2030	New Jersey 2029	Boston 2032
Headline	Doubling down on decentralization	Automation run amok	Re-inventing transit to implode the suburbs	Densification supported by automated logistics
Driving Forces	Cheap solar power, passenger vehicle automation,	Low-cost self-driving vehicle imports, poor inter-operability of assistive and autonomous vehicles	Fiscal crisis caused by costs of severe weather on transportation networks, public support for transit and telecommuting	Housing market shifts towards smaller, connected, single-person dwellings; widespread innovation in small electric vehicles
Land Use & Transportation Impacts	Renewed exurban sprawl, consolidation and expansion of "edge cities", abandonment of transit	Widespread gridlock; decline in walkability and walking, rise of DIY transit networks	Deployment of regional automated bus rapid transit, consolidation of suburbs around existing centers	Extensive upzoning of bikeable sheds around existing transit, rapid innovation in logistics and delivery services

Considering the other scenario examples, the transformation and growth scenarios are affected mostly positive by future innovations similar to the 3R scenario of Fulton, Mason and Meroux (2017). The four-dimensional approach makes more sense when the uncertainty of the future mobility is considered. Townsend brings

up possible regional issues like horizontal settling and parking issues which might be important for system designs. Moreover, aggravating driverless AVs show how ownership can be problematic for AVs' functioning. On the other hand, even though dynamic moving flats and shopping through digital walls seem exciting, they require a well-built system and infrastructure.

Gruel and Stafford (2016) perform a future mobility scenario study involving AVs.

- Scenario 1 (Technology changes but we don't): AVs make no change in people's behavior. Private car ownership continues and in this scenario they assume AVs have a positive effect without major changes.
- Scenario 2 (New tech, new behavior): Larger trips will become more frequent since users can enjoy their time inside the vehicle efficiently. Attractiveness of travelling with a car increases in this situation. Public transit decreases, Traffic congestion increases; considering the rising number of empty AVs. Cities sprawl and efficient land use increases since people can spend time more productively during travels.
- Scenario 3 (New technology drives new ownership models): All vehicles become shared vehicles as an addition to the behavior changes that were indicated in previous scenarios. This scenario has less parking space since the number of cars falls and rebalancing travels may increase traffic congestion. Ride-sharing is not included in this scenario. The results of this scenario are more ambiguous compared to the others.

Overall, Gruel and Stanford's (2016) main idea to reach the positive results of a future included AVs. According to that; AVs may help decrease the attractiveness of traveling by car, increase the attractiveness of public transit. Some of their possible solutions are extending travel time, restricting the luxury and usage of time in the AVs, linking AVs to transit, legislating regional areas, restricting vehicle travels without humans inside.

Compared to the other studies that are discussed, Scenario 1 by Gruel and Stanford (2016) is a default scenario similar to the Business-as-Usual (BAU) by Fulton,

Mason and Meroux (2017). The difference between scenario 2 and 3 is sharing cars' involvement. When sharing cars are involved it helps reduce traffic by decreasing the number of cars. On the contrary, if there is no sharing, AVs may work carelessly and create traffic congestion. This is also similar to the difference between 2R and 3R scenarios by Fulton, Mason and Meroux. (2017). Townsend's study has some more diverse parts than Fulton, Mason and Meroux's (2017) and Gruel and Stanford's (2016) studies since the latter ones based their study only on the variables of automation, electrification and sharing. However, Townsend applies a method based on more variables. He also chooses locations and integrates their specialties to the result. He selects specific years and justifies that by making it, the time interval of too short or too long futures may not be what he was looking for. The reason that this study is included is his different approach, which comes close to *design fiction*, will be described in the next chapter.d

Another study about public transportation's engagement with AVs and travelers' possible reaction to AVs is made by Yap, Correia, and van Arem (2016). In their study, they classified the users in two classes, just like it is in trains (first and second classes). The results show that second class prefer to use bikes or public transportation to AVs to reach the train station. However, first class users prefer AVs. Their study demonstrates that the user's mindset through AV is a remarkable step for attractiveness of AVs. The most significant factor chosen by users was sustainability considerations, second was trust. Therefore, spending time efficiently within the car or service fidelity has a less significant effect on users. It can be added that the studies' location is also an important factor; this study took place in the Netherlands where they use bikes often. As it has already been recognizable among other studies, the city infrastructure plays a very important role for the AVs' engagement.

Finally, CAR (2016) mentions that, future mobility creates wider spaces to work on new services, vehicle concepts, vehicle functions, sharing /ownership systems and business collaborations. In this study, it is intended to work on new vehicle concepts, functions and service/systems through the fieldwork.

2.3 Design Fiction

This section includes a brief history of design fiction, its definition and various applications in the literature, and how it can be adapted to this study.

2.3.1 Definition

Design fiction is quite a new research area. According to Lindley and Coulton (2015a), it aims to investigate future scenarios through fictional worlds. There are some variations about the definition of the term design fiction and there also are arguments on how it should be applied. Most commonly used definition is Bruce Sterling's "design fiction is the deliberate use of diegetic prototypes to suspend disbelief about change." (Bosch, 2012). Even though the main purpose seems to be creating fictional scenarios, diegetic prototypes are at the heart of this definition. Darby, Tsekleves and Sawyer (2018) state that speculative design is an umbrella term for approaches in which designers investigate plausible future scenarios. It aims to cover future technologies but it is not good at producing manufacturable outcomes. It extracts visions through products that may become applicable and it demonstrates products' societal face by questioning legislations, ethics and lifestyles. It creates a playground between real and impossible; it also demands the designer to define new roles, approaches for himself. The authors of the book *Speculative Design* Dunne and Raby (2013), state that speculative design is something that stays more on the critical side of production when it is compared to the design fiction which is closer to the atmosphere of the real world with its "realistic" probes. Sterling (2005, p. 30) also agrees that design fiction has potential of being more practical. Although it forfeits the feeling of miracle, it relates more with technological or social disagreements. That is one of the reasons to combine the potential of design fiction with future mobility. Since design fiction is also a productive ideation, it might also be inspirational for industrial design ideation processes. Moreover, Bleecker (2009) states that design fiction is also a way of

ideation through sketch, mockups etc. It helps to materialize the imagination via narrating and making the outcomes potential concepts. It is also adding a futuristic view since it is related with fiction such as Lindley, Sharma and Potts (2014) state that a successful design fiction process establishes the observer in a plausible future that lets him/her anticipate in a purposeful manner. Therefore, producing concepts within a fictional story world can be applied to the future mobility scenarios including AVs.

Lindley et al. (2014) mention the term *diegetic* with respect to Sterling's use of the term (Bosch, 2012) in the definition of design fiction. They define diegesis as the "world of the story" and they define the term *diegetic* depending on the characters' capability of interaction with it. If the characters somehow interact with them they are diegetic, otherwise they are not. To make design fiction processes imaginable and to strengthen the diegesis, the storyworld needs something that has to express either the story or the world. Lindley et al. (2014) define these as diegetic prototypes. They are also called probes or artifacts and they might be represented as prototypes, visuals, objects, videos etc. Design fiction probes can be designed by some participants or the facilitator himself. That is to say, it can be used as an evoker as well as an outcome. Inside the fictional worlds, probes do work as they are told and this is another feature that makes design fiction special (Jensen & Vistisen, 2017). Thus, regardless of any technological or technical position, the artifacts work as the diegesis directs. It is possible to see design fiction's diverse forms concerning its specific context (Lindley, 2015). How the design fiction process is going to be shaped mostly depends on the facilitator's choice.

2.3.2 Applications

In the previous section, design fiction's broad definition is mentioned and this section will discuss the different applications of the method based on the literature. Arguably, there are some common points between the different methods as well.

Thus, the discussion will be on how it can be integrated into the methodology of the thesis study.

Grand and Wiedmer (2010) propose some methodologies to obtain design fiction as a research strategy. Some ways to apply design fiction are:

- Building story worlds
- Embodying story worlds
- Demonstrating, visualizing the action process

These actions can represent a design fiction study themselves or they can be just a part of it. Grand and Wiedmer also give examples of using these methods through describing case studies. Markussen and Knutz (2013) claim that their study can clarify some issues with the conceptual side of these strategies. They present a four-step method for producing design fictions and their starting point was a narrative text, a novel that is instructed to a group of students. The first step in Markussen and Knutz's (2013) study was writing a narrative. Markussen and Knutz based their study on a background story that was also shared with participants and in return, the participants were asked to produce a one-page scenario by bringing together the base story and memory from their life. Having collected the one-page stories, the facilitators and participants have come together to create what-if scenarios, and later on, they categorized them. The next step was making the diegetics and the participants were guided to produce:

- storyboards,
- microworlds,
- objects (part of that world),
- interactions (can happen in that world).

The last step was to prototype these ideas as a single concept. This is a more specific study than Grand and Wiedmer`s and it is helpful to use as a guide since they also compare their study with other studies. Furthermore, another study by Markussen, Knutz and Lenskjold (2016) works on the combination of fiction and

participatory design. They mention the term perceptual bridge, which is introduced by Auger (2012). The term is meant to create a link between the fictional world and the real world to ease the audience's understanding. Design fiction actually builds this perceptual bridge with probes. The perceptual bridge is important in terms of making the participants believe in the existence of a world within a specific context. Dindler and Iversen (2007) used the perceptual bridge with a narrative for a co-design project by creating a message in a bottle that is imagined as coming from the City of Atlantis. They build a narrative relation between the marine center where the study is held and the lost city Atlantis. The main goal of the workshop is to come up with concepts for the marine center's experience design. A toolbox of mixed objects is also given to the participants and lets participants decide the function of these objects; mirror, flute, cloak, apple. Using the environmental power of narrative is very strong in this study since they do not only write a narrative but also let the participants experience it in a real environment. As it was discussed in the literature, design fiction primarily arises with a what-if question that directs a story world (Knutz, Markussen & Christensen, 2014). Even if the terms like perceptual bridge, what if questions differ, they address the same thing, both of them lead to a fictional story world.

Design fiction is available to include participatory design principles. Unlike *Game of Drones* by Lindley and Coulton (2015b), the study of Nägele, Ryöppy and Wilde (2018) started with a narrative and they improved a method called PDFi (Participatory Design Fiction). Their method seemed interesting because they start the process by sending a probe that triggers the participants to write a narrative text about the design topic Urinary Tract Infections (UTIs). Having collected the responses which act as a preliminary design fiction artifact, a storyboard for the workshop fiction is created by the facilitators. In the workshop, the storyboard acted as a guideline for the creation of diegetic artifacts.

To apply these methods into the thesis study; first, there is a need for a fictional world where AVs might be used. Then, probes that represent the fictional world should be included just as Coulton, Lindley, Sturdee and Stead (2017) state

"(design fiction) narrates worlds not stories". Their entry point diagram Figure 2.11 shows how probes construct a fictional world; probes are demonstrated as entrances for the fictional world. Depending on the scale of the cube surface that consists of the name of the probe, the probe's impact on constructing the fictional world varies.

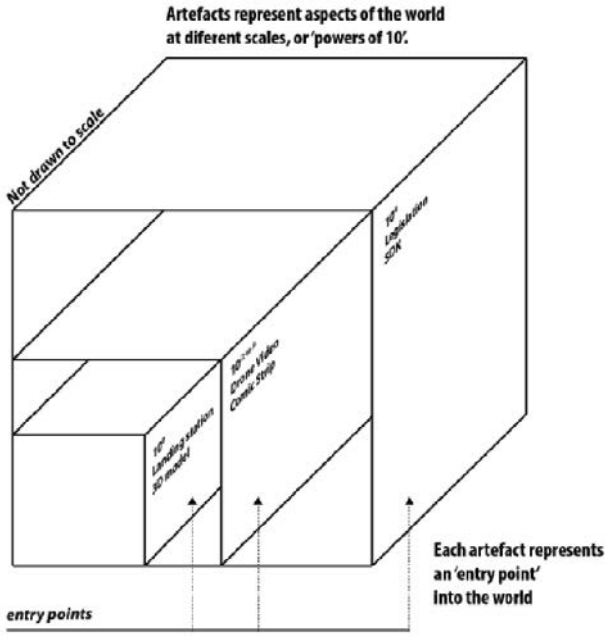

Figure 2.11 Artefacts represent aspects of the world at different scales, or 'powers of 10' (Coulton et al., 2017, p.167)

In the study, Coulton et al. (2017) evaluate this entry point diagram with the case study Game of Drones. Their probes or entry points do not include a narrative base and that makes the study rare. However, they convey the narrative through other probes such as prototypes, users and trial maps. Even though the narrative does not come with a story, it comes with these entry points. In this study, Coulton et al. (2017) hypothetically made a fundamental change in the UK legislation to create this world and the rest (of the artifacts and the world) is pivoted around that. Their design fiction probes were a fictional research paper and 5 min video. As a result, they developed a game that is located in a real city; the users could remotely control drones and there were charging stations for drones around the city. This can

be related to the AV content since there is a need for a change in the legislation for AVs' acknowledgment. Another example that also used the change of legislation is Dunne and Raby's (2013) Micro-United Kingdom example in which they create four different politically grounded storyworlds. Inspired by these ideas, different storyworlds can be imagined that have the appropriate conditions for AVs' activity.

2.4 Summary of the Literature Review

The literature review section had three parts: (1) Future Mobility, (2) Future Mobility Scenarios and (3) Design Fiction. Firstly, *Future Mobility* section built a background knowledge for conducting the field study and secondly, *Future Mobility Scenarios* discussed what this study can focus on by reviewing the other studies from the literature. It also revealed how a designer can approach to a future mobility-focused study by observing the works of other departments. Finally, *Design Fiction* section discussed what design fiction is used for and how it can be adapted to future mobility-focused study. Thus, it helped to structurize the methodology and after the literature review, the study's focus narrowed down to focus on future mobility scenarios with autonomous vehicles.

CHAPTER 3

METHODOLOGY

The aim of this study is to characterize potential ideas for future AVs considering the changes in mobility, transportation and user needs; and this process will be applied using design fiction. Thoring, Mueller and Badke-Schaub declare that workshops can build new ideas, concepts and designs (2020). Moreover, using workshops to create future scenarios is a widely used method. For example, Nägele et al. (2018) used the participatory design fiction method by organizing workshops and interviews to explore product design solutions for medical issues. Blythe, Andersen, Clarke and Wright (2016), organized workshops to produce future ideas by ignoring the technological limitations.

3.1 Data Collection Methods

Three types of data are conducted during the field study: data generated by designers through workshops, workshop observations and discussion of workshops with designers. There are two main parts in the research plan: theoretical and empirical. The theoretical part includes the literature review which shaped the structure of the methodology and created the background knowledge to apply and analyze the methodology process. The empirical part includes two workshops. A framework of activities was designed for the first workshop and minor changes were made for the second workshop based on the analysis of the first workshop.

Two workshops were organized via the video-conference tool *Zoom*. During the workshops, the participants worked on the activities which they performed on the collaborative working tool *Miro*. Each workshop was recorded as a video file and the activities that are employed by participants were collected on the online collaborative working software *Miro*. The main reason for meeting virtually was the

pandemic. Moreover, according to Olson-Buchanan, Rechner, Sanchez and Schmidtke (2007) there is a considerable rise in the number of people who choose to communicate virtually compared to doing it physically. There were also advantages like easily finding participants and easy set-up; according to Cho and Cho's study (2014), virtual collaborations' most liked points were ease of operation and participation, followed by ease of distribution of information, ease of material organization and storage. Cho and Cho (2014) state that having a virtual blackboard seemed efficient for class discussions. Both of the online workshops lasted approximately two hours and the first workshop was performed about a month before the second. Some revisions have been made after the analysis of the first workshop to increase the workshop's efficiency. Primarily the discussion part results directed these revisions.

3.2 Sampling Group

Judgment sampling method is used for selecting the workshop applicants. Marshall states judgment or purposeful sampling as a sampling technique in which the most beneficial participants are selected and this may include choosing participants who have special skills or know-how (1996). A participant pool is defined based on the criteria of being a recent graduate or senior student of design. The reason for defining the participants as designers was their capacity and knowledge of creating scenarios and personas. Since this study is conducted and improved to inspire designers it would be best to try it with the ones who have enough expertise. The reason for not choosing more experienced designers as participants was their changed focus on designing manufacturable products rather than designing concepts during their career flow. The participant should be open to think about future concepts without interrogating production details, cost, etc.

Table 3.1 *Workshop Participants*

Attended Workshop	Participant	Abbreviation	Gender	Occupation
Workshop 1	Participant 1	W1P1	M	design graduate, working as a 3-D artist for a year
Workshop 1	Participant 2	W1P2	M	Second year MSc design student
Workshop 1	Participant 3	W1P3	M	fresh design graduate
Workshop 1	Participant 4	W1P4	F	Senior year undergrad design student
Workshop 2	Participant 5	W2P1	F	design graduate, working as a UX designer for a year
Workshop 2	Participant 6	W2P2	F	First year MSc design student
Workshop 2	Participant 7	W2P3	M	Second year MSc design student
Workshop 2	Participant 8	W2P4	F	design graduate, working as a ceramics designer for a year

The number of participants to be included in the study is defined after the structure of the workshop is designed. To keep the participants active and interested, the workshops should not be more than two hours considering the fact that this is an online meeting. When the timetable of the workshop was designed, the best option was to include four participants for the workshop and punctuation throughout the workshop was crucial. Participants were informed about the structure of the workshop when they were invited. At the beginning of the study, participants were informed about the aim and procedure after that consent form was signed (see Appendix A for the Turkish and English versions). They were instructed to be ready with pencil and papers or tablets that are suitable for drawing. The first workshop participants consisted of three males and a female while the second consisted of three females and a male. All of them were industrial design graduates except one who was a senior year industrial design student (Table 3.1).

3.3 Workshop Design

The future mobility scenarios that were mentioned in the literature review (Chapter 2.2) provided a basis to structure the field study. Most of the mentioned studies focused their study on how the infrastructure of AV systems would function through electrification, automation and sharing (Fulton, Mason & Meroux, 2017; Townsend, 2014). On the other hand, how people would use AVs and how AVs would affect their lives were less explored. Therefore, the study is based on a fictional world idea with AVs' presence in future social life. By using design fiction methodology, workshops are conducted to retrieve direct insights from designers.

Applying design fiction through workshops is a prevalent method (Cheon et al., 2016). By conducting workshops through collective activities such as brainstorming and narrative building, it is aimed to create collective outcomes that take inspiration from each other's performance. Therefore, to encourage group synergy at the end of every activity, a presentation session was added where

participants should present their own way of thinking. As an addition, to evaluate workshops an overall discussion session was held after the activities ended.

Design fictions may start with what-if questions, Markussen and Knutz (2013) used several what-if questions as starting points of narratives in their design fiction workshop since it helps create a ground for the storyworlds. Applying this to the study, the first what-if question was based on having AVs in daily life, to diverge the outcomes there was a need to combine this with other what-if questions: For example, “what if we had AVs in a world with cyborgs?” or “what if we had AVs in a world where telepathy is possible?” etc. To warm up and to see the visions of participants, a brainstorming session was held as the first activity. As explained with examples from the literature, design fiction projects reflect the world it is built on. Since it is aimed to combine design fiction’s approaches with design scenarios there was a need for narratives and personas. Thus, after the brainstorming session, it is continued with a persona building session with which designers are familiar. Although most industrial design graduates are skilled at drawing, there was no reason to create any frustration on this topic. Thus, the next session was formulated as narrative-scenario building, asking for a combination of text and visuals. To ease the participants' directions for future scenarios, inspiration cards are used to support the narrative and sketches of participants. Thoring, Mueller and Badke-Schaub (2020) state that workshops are often used for producing, testing or applying methods, services or products in the design research. Finally, a discussion session was organized as the last part of the workshop in which the participants talk about the experience they had, the pros and cons of the workshop and discuss each other's works.

3.4 Workshop Process

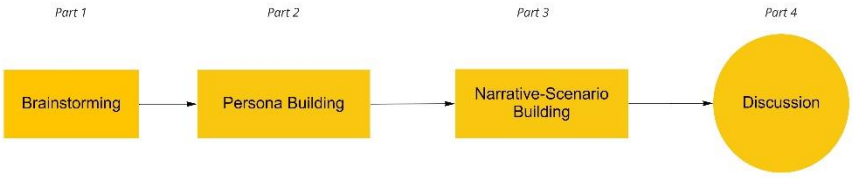

Figure 3.1 Workshop Structure

The workshops were conducted in four phases (Figure 3.1) and participants used Miroboards to deliver their work (see Appendix B). *Brainstorming* was the first exercise of the workshop. After meeting with the participants and a short ice-breaking conversation, the brief was given as:

"We are in the year 2040 when it is possible to have AVs on the road with the legislation changes and high technology. Using the post-its, write down the keywords, terms etc. that come to your mind when you think of a world like that." (see Appendix B for the

Six areas; politics, economics, social life, technology, environment, transportation, were defined to ease participants' thinking process and participants used post-its to represent their ideas (Figure 3.2) (see Appendix C for the original Turkish version).The participants had three minutes to complete the exercise. ARUP (2017) has graphically represented how the possible improvements on AVs are going to be. They assume that by 2025, 25% of the vehicles that are in traffic are expected to be AVs and this percentage increases 75% in 2035 and it will reach its' full condition at 2064 (2017). Thus, it was possible to try different years and see its effect and "2040" for the first workshop and "a year between 2040 and 2060" for the second workshop were defined.

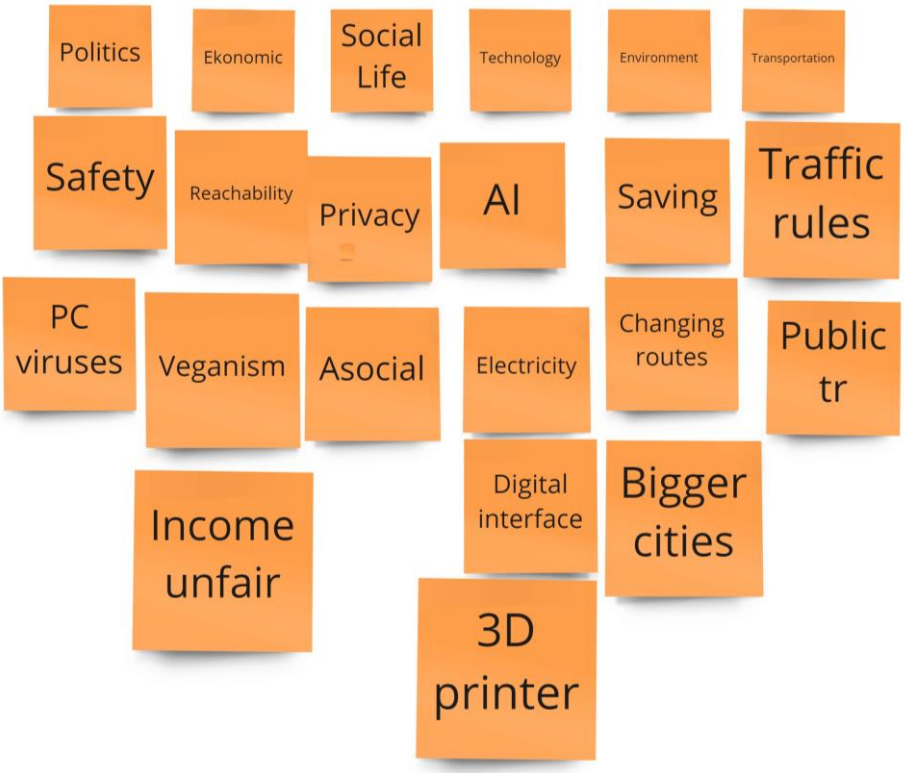

Figure 3.2 Brainstorming of W1P1 (English version, translated by the researcher)

Persona, the second exercise of the workshop was based on character creation and this character would be the protagonist of the narrative and scenario. For the sake of not shaping the imagination of the participants, it is not asked from participants to define persona directly as the user group of AVs. By finishing the first step, the participants already had some visions about the future world. In addition to that background, the exercise was created including guide questions for participants to determine some information about this character such as wishes, personality, interests, habits, age etc. (Figure 3.3) (see Appendix D for the Turkish template).

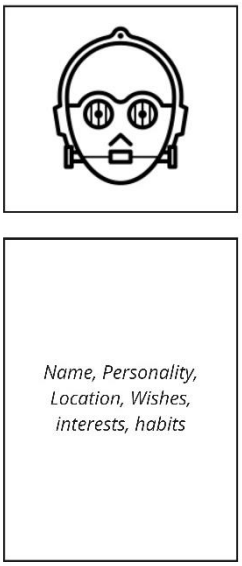

Figure 3.3 Persona template (English version, translated by the researcher)

Narrative-Scenario, the third and fourth exercises of the workshop, was the place where a sequence comes up including the character of the story and its setting. For this exercise, specific cards for future issues were designed to help the participants build their narratives. They were categorized in two groups: social and technological issues. The reference points of these cards come from Lean Service Creation Canvases by Futurice (n.d) and "The Thing From the Future" by Candy and Watson (2013) (Figure 34). Moreover, participants were asked to create scenario-narratives on a template in which the inspirational cards were included as well as guiding questions (Figure 3.5) (see Appendix E for the Turkish version).

Figure 3.4 Inspiration cards: Inspired from Lean Service Creation Canvases by futurice.com (Futurice, n.d) and Stuart Candy and Jeff Watson's (2015) "The Thing from the Future" card deck

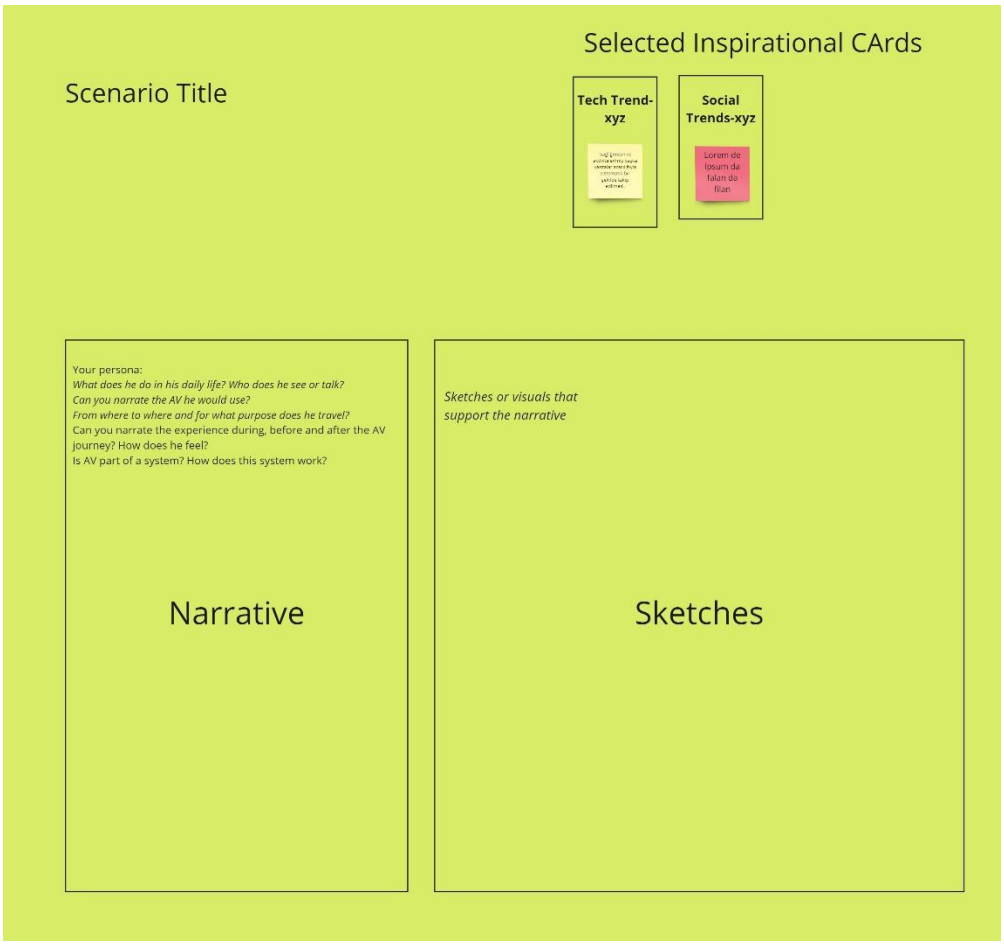

Figure 3.5 Scenario-Narrative template (English version, translated by the researcher)

Discussion is the last part of the workshop in which the participants talk about the experience they had, the pros and cons of the workshop and each others' works.

3.5 Data Analysis

A qualitative analysis approach was followed to analyze raw data. There were two and a half hours of video recording and four miroboards from both of the workshops. There were both visual and written data on the miroboards. First part of the workshop produced written and vocal data, while second and third parts of the

workshop produced written, visual and vocal data, and fourth part consisted only vocal data.

First, all the voice recordings were transcribed in the form of a Microsoft Word document including the interactive discussion part. The workshops were conducted in Turkish and the data was obtained in Turkish, and they were translated into English by the researcher. Transcriptions were read several times with respect to visual data produced by participants (Appendix G). Figure 3.6 shows how visual data and transcriptions were analyzed together for W2P4's Persona Building part. Every participant's data was coded separately following this method as the first round of coding. For the next step, the codes were read again and put under categories (Appendix H). Three different pieces of data appeared, (1) codes that are related to future scenarios, (2) workshop format and (3) participant strategies. Later on, the workshop outcomes related to future scenarios were also divided into two groups: *Storyworld with AVs* and *Features of AVs*. However, some data was still standing in between these categories. Thus, these data were used as a bridge while discussing the findings. The data related to the *Workshop format* mainly was coming from the discussion sessions and the data related to *Participant strategies* were produced while analyzing the transcriptions and visual data together.

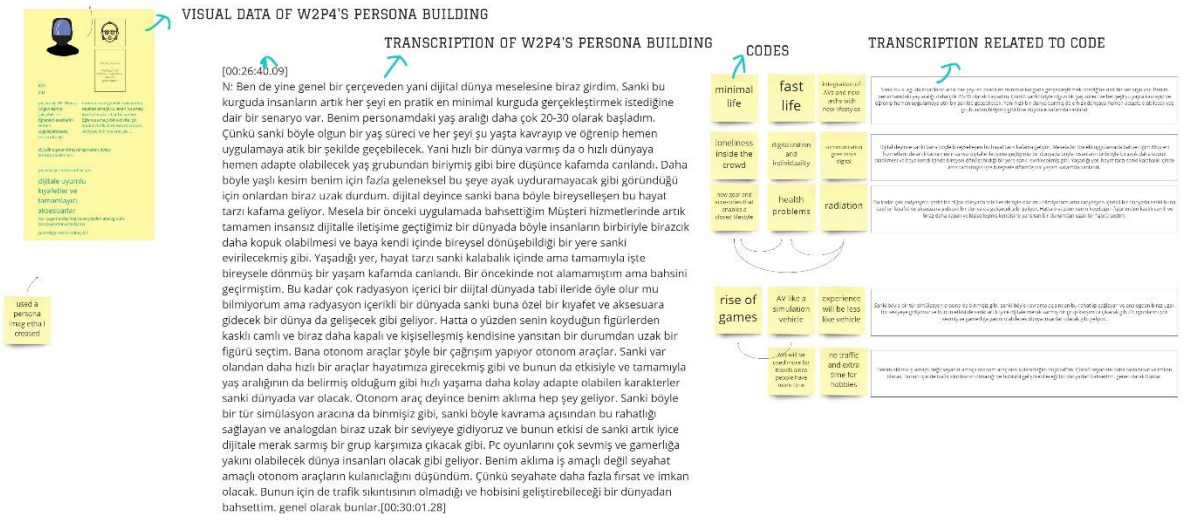

Figure 3.6 W2P4's Persona Building Data Analysis

CHAPTER 4

FINDINGS AND DISCUSSION

Workshop outcomes are categorized under three headings; outcomes related to future scenarios, workshop format and participant strategies (Figure 4.1).

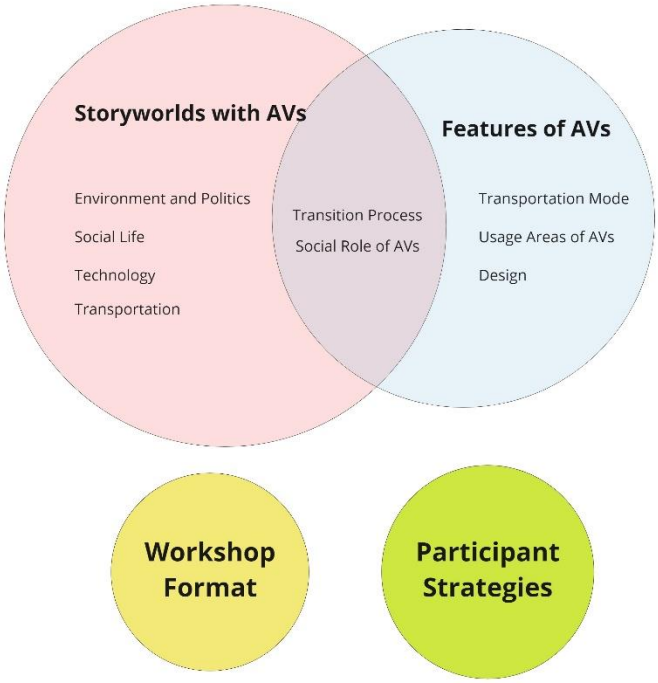

Figure 4.1 Structure of the findings

4.1 Outcomes related to Future Scenarios

Workshop findings related to future scenarios were documented in the form of two code trees. The two main categories of the outcomes were *Features of AVs* and

Storyworld with AVs, meaning that the former is about the vehicles and their features whereas the latter is the data about the fictional world these vehicles settled on.

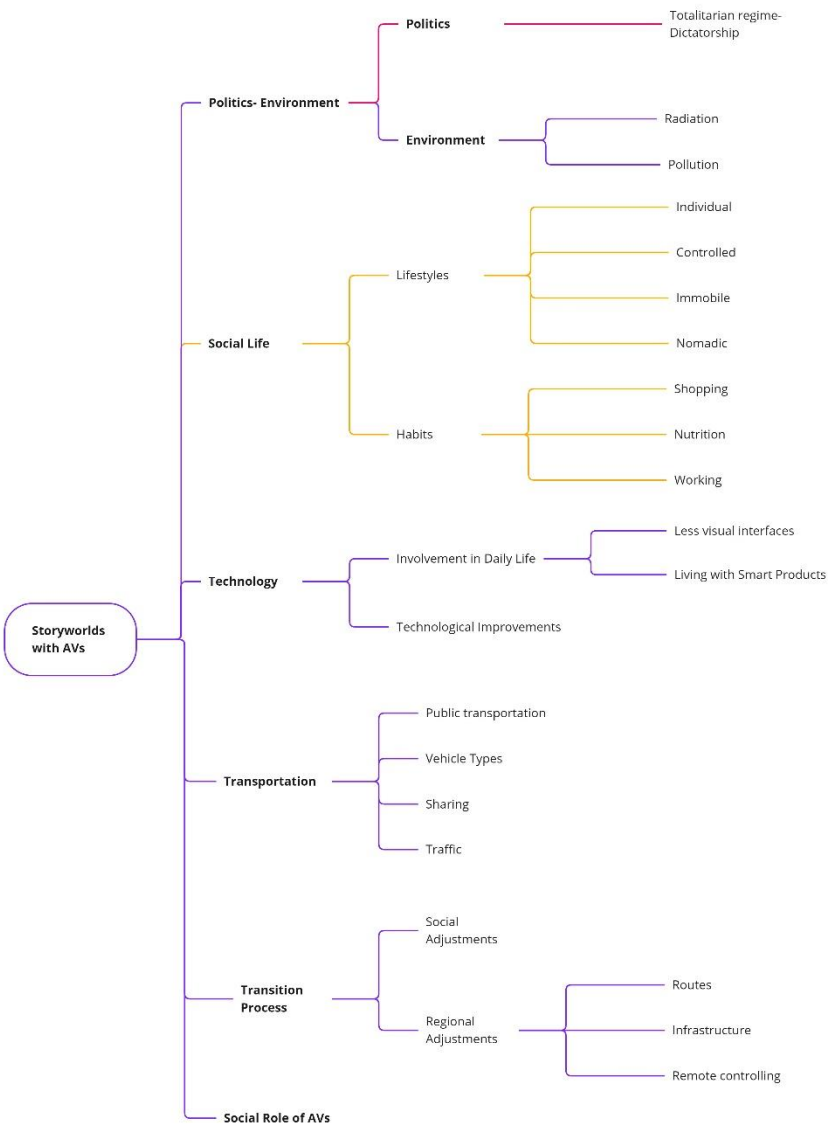

Figure 4.2 Outcomes related to Storyworld with AVs

Figure 4.2 shows the outcomes related to Storyworld with AVs part, describes how the fictional world with AVs would be shaped. Therefore, it has the general world issue titles which are *Environment and Politics, Social Life, Technological Improvements, and Transportation*. This categorization nearly matches with the categorization that was created for the brainstorming of the workshop, which had six categories: *Politics, Economics, Social Life, Transportation, Environment, and Technology.*

Social Life title of the Storyworld with AVs category, involves most of the outcomes since the workshop included lots of social areas to dig in like persona, narrative and scenarios. The second most appearing outcomes were under the title of *Technology*, which is not surprising since we are searching around the future. *Politics and Environment* title involved less data because they are global issues and participants needed to focus more on features of AVs and lost their interest in these topics after the brainstorming session. A few participants talked about them in their scenarios, the rest of the participants structured their scenarios in different areas. *Economics* had very little data so it is excluded from the analysis. Starting from transportation; *Social Role of AVs* and *Transition Process* titles will be a bridge to direct the way of explanation to Features of AVs which is more related with AVs themselves (Figure 4.1).

Features of AVs part have concepts, ideas and proposals for AV design both for system and product level. They are categorized under three titles: *Design, Usage areas of AVs* and *Mode of Transportation*. The majority of outcomes were under the Design title and the other two categories have a proximate number of outcomes.

4.1.1 Storyworlds with AVs

In this section, features and issues related to the storyworlds that are built by the participants are discussed.

4.1.1.1 Environment and Politics

When it comes to the environmental aspects of the storyworlds that were created by participants, the focus was mainly on the environmental problems. Noone seemed to have a positive word for the future environmental state of the world; hence with issues like global warming, depletion of natural resources and pollution, most of the storyworlds involve damaged natural lives.

Radiation

About the environmental aspects of the storyworld, a directly considered issue was the effect of radiation. W2P4 located radiation as a critical issue for her scenario. She stated that the radiation would increase health problems and this would force people to change their lifestyles. Thus, she created a persona who is wearing a protective costume. Going even further, she stated that this kind of situation might affect fashion trends and clothing choices of the world and it makes sense considering how masks became a part of life during the pandemic. It is visible that after masks had become a must, people saw them as an accessory and started designing them and combining them with other clothes.

Figure 4.3 W2P4's persona avatar, who is wearing a protective costume to prevent radiation, and descriptions

Pollution

With the increase in air pollution, W1P2 stated that people would use confined spaces even more which is similar to the radiation case. Moreover, he added that it is possible to see outdoor activities becoming indoor and consequently this may increase the number of people that own individual lifestyles and subsequently, the number of closed societies. Other than that, W2P2 mentioned that the increase in soil pollution might raise the use of hydroponic agriculture. This might affect the trends in food commerce and consumption behavior.

Politics

Political issues of the storyworlds are not mentioned much. Only W1P4 preferred to give the government an essential role in her scenario. She created a dystopia where automation and machines replace humanity due to government policies. She explained it as,

> [1] There is a mechanical harmony within the system. Everything is in a loop; if there is a malfunction or breakdown, it is determined immediately and fixed (W1P4).

As a result in her storyworld, humans start to have fewer emotions and they have their lives controlled by the government. In this storyworld, there is an artificial environment with advantages like free transportation and the happiness of not thinking too much. She also stated there are social classes created mainly by income inequality. It can be observed that W1P4 followed a different strategy than other participants from the beginning of the workshop. She created a strong background for her storyworld; placed her persona and scenario concerning that. For that reason, her storyworld has more details compared to the others. Thus, it can be said that the storyworld building process may start from a more extensive scale like in this example; hence the brainstorming process could be structured in a way to emphasize this approach (Figure 4.1) (see Appendix F for the Turkish version).

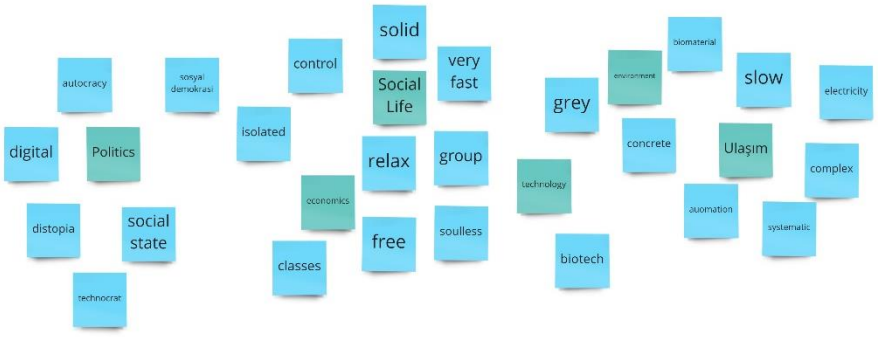

Figure 4.4 Brainstorming of W1P4

Ethics

Ethics of vehicle automation is a growing and trending issue in the literature and expectedly it is brought into the discussion by some participants. From an AV-based perspective, W1P1 and W1P3 stated that new privacy and security laws would be required for the user since the companies may record data about the users' daily life using the AV's capacity. Another legal issue was the need for new traffic rules for AV-ruled traffic which will also be mentioned in section 4.1.4 Transition Process-Regional Adjustments.

Political Effects of Environmental Problems

Participants also mentioned other social and political effects caused by environmental problems. On a global level, W1P3 discussed the possibility of resource problems and he expected governments to become stricter about energy-saving behavior in the future. On a sociopolitical level, two participants stated that they expect an overpopulated world. This situation would increase immigration and, consequently, refugee problems.

4.1.1.2 Social Life

Social matters of the storyworlds were frequently mentioned by the participants. There are very diverse outcomes about the lifestyles of the personas in terms of social perspectives. Some lifestyles can be directly related to AVs, like the nomadic lifestyle, while others may be related to different improvements, primarily technological.

Lifestyles

Individual Lifestyle: The first lifestyle mentioned by participants was the individual lifestyle. It is inevitable to see people spending more time at home with the recent technological improvements, which symbolizes an isolated life that includes less social life. W2P4 used the expression “less human to human connection” to describe that case. It is interesting because she actually meant the physical connection by that. At that level of technology, the physical meetings and connections seemed to have a severe decrease. Moreover, W2P2 stated that with the rise of individuality, people have more isolated lives and this may lead to an increase in the number of pet owners. She even thought of pets as potential users of AVs during brainstorming, even though she did not use that in her scenario.

Controlled life: Another lifestyle stated by the participants, primarily by W1P4, was a controlled life. It was also mentioned in section 4.1.1.1 Environment and Politics- Politics. The participant structured her narrative within a political ideology, then worked on her persona and narrative. She defined the lifestyle for the citizens of this world as “controlled lives”. She expressed this as “Everything is scheduled and in order, people are connected to their timers and reminders.” Everything happens in time within this world and people have minimalized emotions. Citizens have no free will, hence they are living in a routine like robots but they are happy.

Immobile Lifestyle: Participants considered “immobile lifestyle” based on the issue of health. As it was indicated before, technological improvements are leading people to a less mobile lifestyle. W1P2 mentioned that his persona always stays home since he can handle everything this way. He also added a possibility of an increase in the number of obese people due to keeping this lifestyle.

Diversity-based Lifestyle: Inspired by the given card LGBTQ, W1P2 commented on a diversity-based lifestyle. He stated that with the increase in cultural diversity and acceptance of different cultures, people will start to have multi-cultural

networks. On an exaggerated level, this idea may lead to one common nation utopia that is able to contain different cultures and languages.

There are other lifestyles muddled around by participants like “fast life”, “minimal life” and “relaxed life”. Fast life is mainly related to young people who are getting bored quickly and shifting through places and people at a pace. A technology-based minimal life relates to consuming and owning a minimum amount of things. Considering the domination of AVs and smart products, some participants considered having a less stressful life. However, there was a debate on whether this would make things more relaxed or not. Finally, one of the most interesting outcomes of the workshop is the nomadic lifestyle, which depicts a persona that lives in his AV is mentioned by W1P1 and it will be elaborated on in the section 4.1.1.2 Social Life-Habits-Working Habits section.

Habits

Continuing with the social attributes of the storyworld, it is meaningful to talk about new habits that arise from new lifestyles.

Working Trends and Habits: With the COVID-19 pandemic, the working styles have already started to change. However, during the workshops, it is seen that AVs can give a new dimension to working habits. Inevitably, in a world with only AVs, driver jobs will be lost or transformed. This is mentioned in the second workshop by W2P1 and W2P2. To exemplify the transformation of driver jobs W1P4s narrative can be noted, which mentions distance controllers of AVs. Distance working style is already spreading, but another spreading working habit is freelance working. In both of the workshops, participants created freelance working personas. It was interesting to see the combination of distance and freelance work with AVs.

W1P1 formed a workaholic persona, for that reason he carries his office everywhere and AV becomes his office. This persona can carry out projects from multiple disciplines. The participant tried to examine the issue of multi-sectoral

working since he believes it is a trend. Similarly, W2P1's persona is a freelance and distance worker and she does that while traveling the world with an AV. Additionally, W2P1's persona was a creative writer, which led the discussion into the issue of creative jobs of the future; whether AI-based products are going to replace humans in creative jobs as well. In her narrative, the persona gets help from her AV to be more creative. This might be a positive scenario similar to the situations when people get help from the internet as an inspiration source. On the other hand, it is also an example of how AI-based products replace a human's role. In this example, AI is just an assistant and it is also possible that products themselves can be creative through machine learning. Thus, they might also replace the persona's role.

Shopping Habits: Recently, it can be observed that shopping habits are radically changing. Digitalization, especially e-commerce, created a massive shift in shopping habits. This has never been a center for the discussion but participants considered the spread of 3D printers and discussed the practice of buying digital models of products to print at home. This kind of consumption practice actually requires a system design that enables owning a 3D printer at home with proper material qualities etc. However, when the increasing hours that people stay at home is considered, that does not seem hard to grasp as a certain behavior with sufficient technological possibilities.

Nutrition Habits: The topic of nutrition habits was mainly positioned around the consumption of meat and capsule foods. Moreover, capsule foods and supplements may directly affect consumption habits. Especially considering the comfort and independence created by AVs may lead people to cook less and continue with capsule foods. Other than that, a few participants defended the idea of a continuation of the increase of veganism and vegetarianism. However, it is not easy to see whether this is just an increasing trend or it will really affect the future nutrition habits constantly.

4.1.1.3 Technological Issues

Technological Improvements

The technological improvements are mostly the outcomes of the brainstorming part since some participants changed their strategy after seeing the inspiration cards on the third exercise and continued working on a different topic.

First of all, it might be beneficial to remember that the participants were briefed accordingly: "We are in the year 2040 when it is possible to have AVs on the road with the legislation changes and high technology. Using the post-its, write down the keywords, terms etc. that come to your mind when you think of a world like that." Hence, there were some gaps that needed to be filled by participants in this brief. For example, high technology and legislation changes were not defined intentionally. Thus, participants were free to define how high the technology level is or which legislations are changed. There was a tendency to reflect the vehicle autonomy as an "autonomous world order" in the scenarios and narratives. The participants used words like "in this autonomous world", and "considering the autonomy of the world" which shows that they believe there is a high level of autonomy required for the rest of the world to be able to accommodate AVs. It can be speculated that the motivation for this tendency is that AVs require an infrastructural change both physically and technologically which actually means that many things would go autonomous before AVs' presence.

According to most participants, digitalization is a crucial topic for future technology since it directly affects daily life. Gaming and digital shopping were the prominent issues born from digitalization during the brainstorming phase. However, participants did not elaborate on these topics.

AR/VR technology is going to be a game-changer for future lifestyles. However, it puts people away from the real-life experience. Related to this issue, W1P4 stated that it is possible to have digital life and real life similar to each other since real life gets more artificial and digital life becomes closer to reality. The participant also

added the possibility of getting used to the artificial lifestyle and losing the connection with natural life. The participants' expression is of course, at a speculative level. However, humans are very fast at adopting new behaviors and they quickly forget former practices within a highly technological lifestyle. Thus, it is possible to have an entirely artificial life in the future where people even forget their former behavior. It is also possible that there will be a transition process where people confuse real life with artificial life.

Technology Involvement in Daily Life

Living with smart products: Some of the expressions included in this section come from the inspirational cards designed for the workshop. However, the term "cyborg" was used by W1P2 during the persona creation phase which was before presenting inspiration cards. Later on, the participant supported the narrative using the inspirational card "having mechanical body parts". It was breathtaking for future narratives to consider a cyborg as a persona. Moreover, the needs and habits of a cyborg will also open up new perspectives for designers.

The same participant also mentioned possible symbiotic relations between smart products and people:

> [2] I dreamed that he liked to do sports at home, and that he had a symbiotic relationship with some living things at home, and I thought of these living things as products, as if he were looking after each other mutually with living things. It's like creating its own habitat inside the house. Here he is having problems in personal relationships. I thought it produced its own energy at home from algae. (W1P2)

As the products get smarter the meaning of human-product interaction is changing. It is possible to say that humans are interacting with products similar to the way they do with humans since they can communicate with products through speaking, gestures, and touching. AI's effect in this situation is inevitable and it is going to cause a major change in people's lifestyles (Montalvan, Shin, Cuellar & Lee, 2017). Anthropomorphism can be a crucial method for responding to users' needs while communicating with smart products.

Less Visual Interface: It has already been mentioned how participants brought out digitalization as a central point for the future. However, W1P2 was aware of another possibility and he declared that “mind power” may replace digital interfaces in the future. This is interesting because it is a vision of a future where there are fewer visual interfaces. Thinking about what kind of challenges that situation may create for designers is promising. Additionally, the participant used the inspirational card “neurolink” which addresses a similar issue. Also W2P1 thought that there could be more sound or gesture design needed in the future rather than touching screens, which supports the idea of having less visible UI in the future.

Technology and Health

As it is mentioned in the radiation case, health is an issue that was put forward by participants. Issues related to health are the results of diverse issues that were expressed by participants. Even though the medical technologies are improved with services like person-specific treatments as W1P2 stated, technological improvements have also negative effects on health issues. For example, W1P2 thought that people will walk less in the future due to technological improvements, AVs can be one of them, and as a result of this behavior, there might be an increase in the number of obese people. W1P2 also mentioned the possible increases in the number of infertile people. Even though it is not directly stated by him, radiation which is previously mentioned may be a reason for that. W2P4 considered that digitalization might also create a rise in the optical problems which was also one of the motivations behind her persona wearing a protective costume. Health issues directly impact people's lifestyles as it is seen during the COVID-19 pandemic. Thus, designers have to consider how health services will be part of new lifestyles while creating future scenarios.

4.1.1.4 Transportation

Sharing AVs, public transportation and traffic issues are impacting each other in different manners. As discussed in the literature review, Gruel and Stanford (2016) have studied AVs' possible effects in the long term. They accepted that AVs would increase the appeal of having a journey with vehicles. Based on that, they worked on three scenarios to analyze how different situations affect factors like traffic congestion, number of trips per day, travel time, number of cars in the region, public transportation etc. However, as Gruel and Stanford state there are lots of variables for a future with AVs from a transportation-based view and this thesis is based on the storyworlds of the participants. Hence, the outcomes are just reflecting the participants' perspective based on their diegesis.

Sharing: It is still an ongoing discussion whether shared AVs or owned AVs are going to dominate the industry in the future. Participants also have different views on this topic. This issue is also related to the reachability and affordability of AVs. Because sharing services have an economic upside for people's choice. It will be detailed in the section 4.1.1.6 Social Role of AVs.

Traffic: Some participants mentioned that AVs' existence might bring down the traffic congestion. It seems to be possible in a future where all vehicles are AVs since it creates a different kind of chaos in traffic when AVs and non-AVs are in traffic together. This was also stressed out by W2P3 as the requirement of new traffic rules considering the replacement of human drivers.

Vehicle Types: "What kind of vehicle types will there be in the future?" is an inspiring area for designers to speculate on. W1P3 realized that when all the vehicles are AVs, AV will not be a category and we will need to categorize AVs within themselves. This can be related to the usage flexibility of AVs that were discussed during the workshop by W1P1 and W1P3. Thinking that way, it is possible to have a future with fewer vehicle types but with more options. Since the

vehicles are flexible they can serve different needs. The word flexible refers to the transformation and service capacity of a vehicle.

Public Transportation: The state of public transportation in the future has different visions reflected by participants. Actually, public transportation and sharing versus owned AV issues should be considered together since they are kind of substitutes for each other. “The more owned AVs, the less public transportation” is the view of W1P3 and in his storyworld this reflects as a major part of population that owns an AV.

4.1.1.5 Transition Process

Transition process part includes the exploration of issues related to “transitioning to life with AVs” rather than “life with AVs”. This was not an issue that is expected to directly come up and be a part of the scenarios before the workshops. However, it was expected that issues like infrastructure and trust would be a discussion point in the workshops. Unsurprisingly, building trust in AVs is brought out by the participants and it is a very trending issue when AVs become a topic of conversation. Indeed, W1P3 located the issue of “transition to AVs” at the center of his scenario. He focused on issues of the transition process to a future with AVs. It is possible to see outcomes from both the future with AVs and the transition process to AVs in his workshop data. Moreover, his focus on the transition process affected some participants to consider this process as well. Thus, it was possible to collect data from different participants on the transition process to AVs. The outcomes which are related to the Transition Process is discussed in two groups below: *Regional Adjustments* and *Social Adjustments*.

Social Adjustments

Adaptation to technological changes is one of the biggest barriers against the transition process of AVs. During the workshops, the generation gaps and the

differences between speed of adaptation are mentioned. W1P3, who built the scenario of an elderly persona during the transition process, stressed out the lack of knowledge these people need to overcome for easy adaptation. The situation can be observed from a wider technological perspective rather than just an AV-based perspective. Thus, W1P3 defended that informational support should be given to the artisans and locals for the adaptation to high technologies. They might benefit from technological improvements while they carry on their traditional professions. On the other hand, teenagers are adapting very fast to the new life standards. This polarity may create new social problem areas for system and service designers.

Regional Adjustments

Infrastructure: One of the most crucial steps for AVs' existence is having the proper infrastructure setting for their functions and more than half of the participants mentioned this issue. During the literature review, the issue of infrastructure and connectivity has been discussed. For AVs' proper workability, Principles of connectivity; V2I (Vehicle to Infrastructure), V2V (Vehicle to Vehicle) and V2X (Vehicle to Everything) have to work and they require a decent infrastructure to function. For their most effective use, AVs need a smart city infrastructure. In this context; e*volutionary path* (Chan, 2017) which supports that AVs spread progressively and *something everywhere* (Chan, 2017) view which supports that AVs function with their all capacity but in limited regions can be considered. It can be speculated that AV deployment might happen similar to the deployment of historical ages which had not been experienced at the same time in every society. Same principle might even be applied to all technological deployments, developed countries are the first ones to put them into practice and then others follow them.

Routes of AVs: Participants have different visions of how and where AVs may move in cities. W1P3 declared that we understand AVs only as road vehicles because we only hear car companies making improvements about them. This might

be a common fact about understanding AVs but in the workshop, designer participants demonstrated that they have a broader vision. Participants discussed the definition of roads considering AVs' existence. For example, W1P3 proposed that AVs' and peoples' routes should be separated and some intersection points may be designed for their meeting. The same participant also considered the environmental side of this issue and put the idea of structuring AVs routes in a way not touching nature. These ideas are inspirational starting points for the system design of AVs. Even though these proposals are on a regional scale these are considerations that directly indicate design issues.

How AVs' existence may impact the state of urban life was another question that was discussed in the workshops. This is also mentioned by Fulton, Mason and Meroux (2017) and it is expected that when cities have AVs it will increase the trend of horizontal settling since journeys will become more efficient. However, would this situation direct people to rural settlements when it is combined with individuality and increased mobility possibilities or is it just more horizontal cities with long-distance travels?

Remote controlling AVs: Remote control of AVs were mentioned in the workshops as the participants design the routes of their AVs (Figure 4.4). Another possibility that AVs could create with a smart city is parking them outside the city for less space occupation and traffic. W1P3 narrated it as the user could remotely call the vehicle when he needs, and he added that when it is combined with sharing, this could lead to fewer vehicles and less traffic in the city. In a different context, public AVs are distance controlled in W1P4's storyworld. She expressed this as:

> [3] Through the swarm robotics technology (inspirational cards) the vehicle reaching habits of the officers are determined and using that information the speed and acceleration of public AVs are arranged. If the officer had problems getting used to that routine, the punctuality gene is injected using CRISPR technology (inspirational cards). (W1P4)

W1P4 did not just design the routes but also considered how these routes may function. The purple line is AVs' route and they also signify streets (Figure 4.4).

Circles represent the public housing of this world where officers live. Thus, they are tracked and connected from their houses to works. This kind of control mechanism is related to her storyworld's "controlled lifestyle" motto.

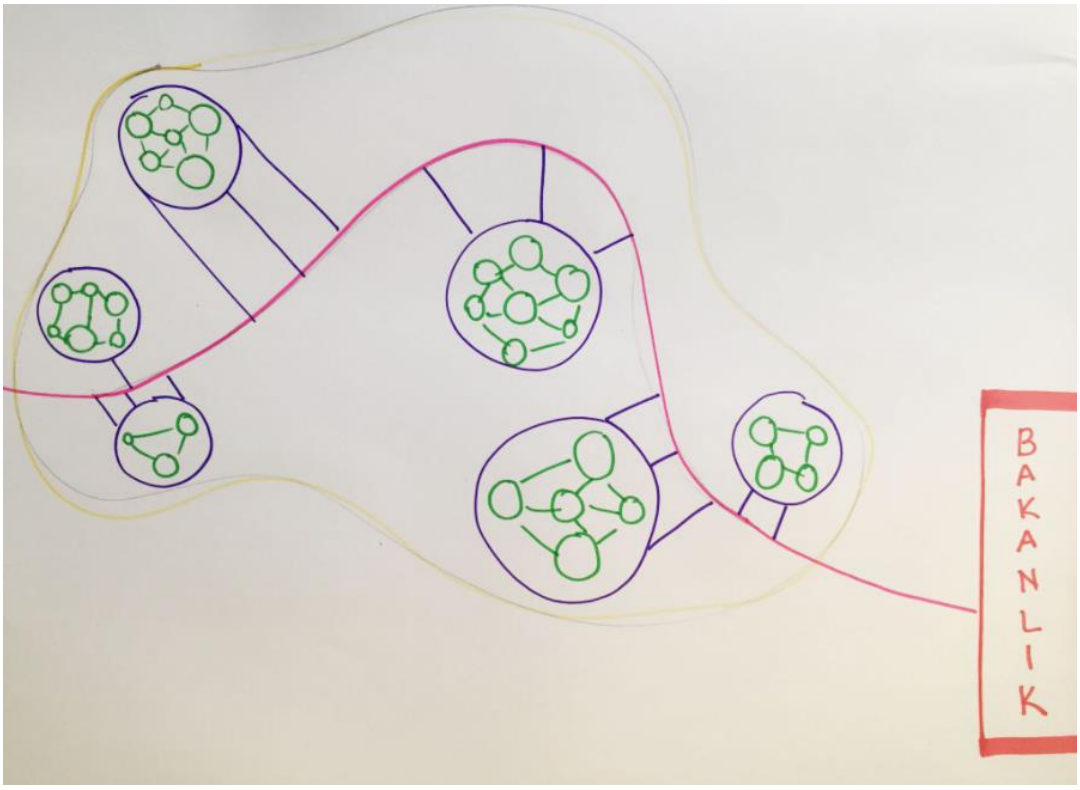

Figure 4.5 Routes of W1P4s storyworld

4.1.1.6 Social Role of AVs

In this section, the outcomes are related to the social role of AVs, where AVs' function as a transportation vehicle faded. During the previous sections, W1P4's storyworld and its political background have been mentioned several times. She created her scenario of AVs where they were for common use similar to public transportation. She defined AV as a "time catcher" in her storyworld:

> [4] In the AV journeys people can finish their own works that they could not find time to perform. They can brush their teeth, read newspapers, make family/neighbour conversations. That is the interaction that they can have in AVs. (W1P4)

The participant called this as "no driving pleasure, yes reaching satisfaction", she also emphasized the value of not being late as a plus to efficient time management. The majority of participants talked about AVs' possible benefits for efficient time management. The issue of AVs' role in efficiency is provocative because at this level of AV discussions; AVs' function as a transportation vehicle is on a secondary level.

Analyzing the workshop, it is visible that some participants were creating their scenario by asking the question, "what does AV mean to my persona?". The outcomes of this question are fascinating. Since AV uses AI-based technology, the vehicle has intelligence and when it is combined with factors like individuality and mobility; AVs become friends, slaves or assistants of the personas that are included in the scenarios. For instance, W2P4 stated that AV and the persona plan the journey together, the participant emphasized the part that the persona does not order AV to do anything but rather they do it together. Moreover, the participant stated that the persona does not live in AV; but she lives with AV. Similarly, W2P1's persona travels worldwide with her AV while working remotely and freelance. The persona's work needs creativity and she considers AV's opinion. This scenario has been mentioned both in the working habits and lifestyles titles. It is also a combination of freelance work and slow travel, that is why it was

meaningful to call it “nomadic lifestyle". This kind of social role takes AVs’ place from a vehicle to an anthropomorphic object, which shows that AV is much more than replacing the driving activity in people's consciousness.

In a different context, W1P1 called his AV “office AV”. His persona was using AV as an office and living area, even for sleeping during required occasions. In this scenario, AR/VR technology has an important role. It is used to change the ambiance of an AV, from an office to a living room. In some situations, AV becomes a place to conduct meetings with other colleagues. Thus, AVs’ emphasized role is defined as living and working space rather than assistant or friend in W1P1s’ scenario.

Through the existence of AV, W2P4 questioned the definition of the journey with AVs. Her persona sees AV as a friend and lives with her AV. She mentioned that her persona's journey starts after she gets off the AV since being inside of AV does not signify a journey anymore. What W2P4 does is go even further and eliminate the AVs’ transportation function. This is a very provocative perspective which redefines travel behavior. The participant also declared the effect of AR/VR technology to achieve this in her scenario which was discussed in Section 4.1.1.3 *Technological Issues- Technology Involvement in Daily Life*.

Two different participants mentioned that with AVs on the roads, it will be possible for people with no driving ability to have independent mobility. This independence will create new user groups such as the elderly, children, and disabled who would travel alone in a private vehicle. In addition to that, considering leaving the driving activity to AI, the driver jobs will be lost. Some participants also questioned the jobs of taxi drivers, minibus drivers etc. New job types like not driving these vehicles but controlling them at systems level might be adapted with remote working which has already started rising.

4.1.2 Features of AVs

In this section, the analysis of outcomes that are directly about AVs themselves and their features will be given (Figure 4.6).

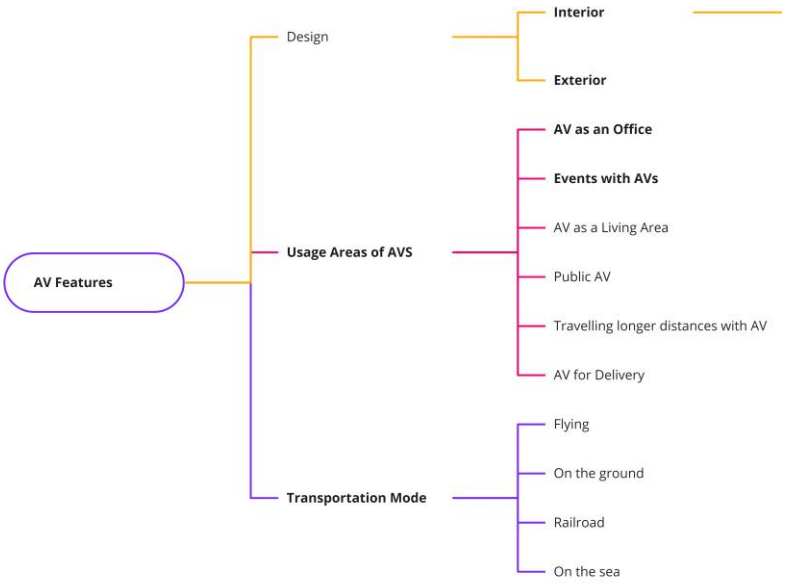

Figure 4.6 Outcomes related to Features of AVs

4.1.2.1 Mode of Transportation

In Section 4.1.1.5 *Transition Process-Regional Adjustments*, the routes of AVs issue was discussed formerly without elaborating on modes of transportation. However, participants also portrayed how AVs move on those routes. Surprisingly, very few of them designed their vehicle concept moving on the ground. Most of them considered their vehicles' movability in the sky or offering different options such as moving on the ground, water and railways. For example, W1P3 designed a flying AV for cargo deliveries (Figure 4.5). In this concept, the flying AV contains drones and these drones leave the vehicle for delivery and come back when the delivery is done. Other than that, W1P4 narrated his AV moving on the rails which are defined as the streets of the participants' storyworld. It can be speculated that participants did not believe that AVs can be integrated into the current

transportation system if they move on the ground, 2040 might be too close for all that infrastructural change to happen. Thus, instead of putting them on the ground, they designed them as flying or railing. Another reason behind this motive was environmental. W1P1 claimed that he/she does not want AVs to harm natural life so they should have a route that did not touch or endanger the environment.

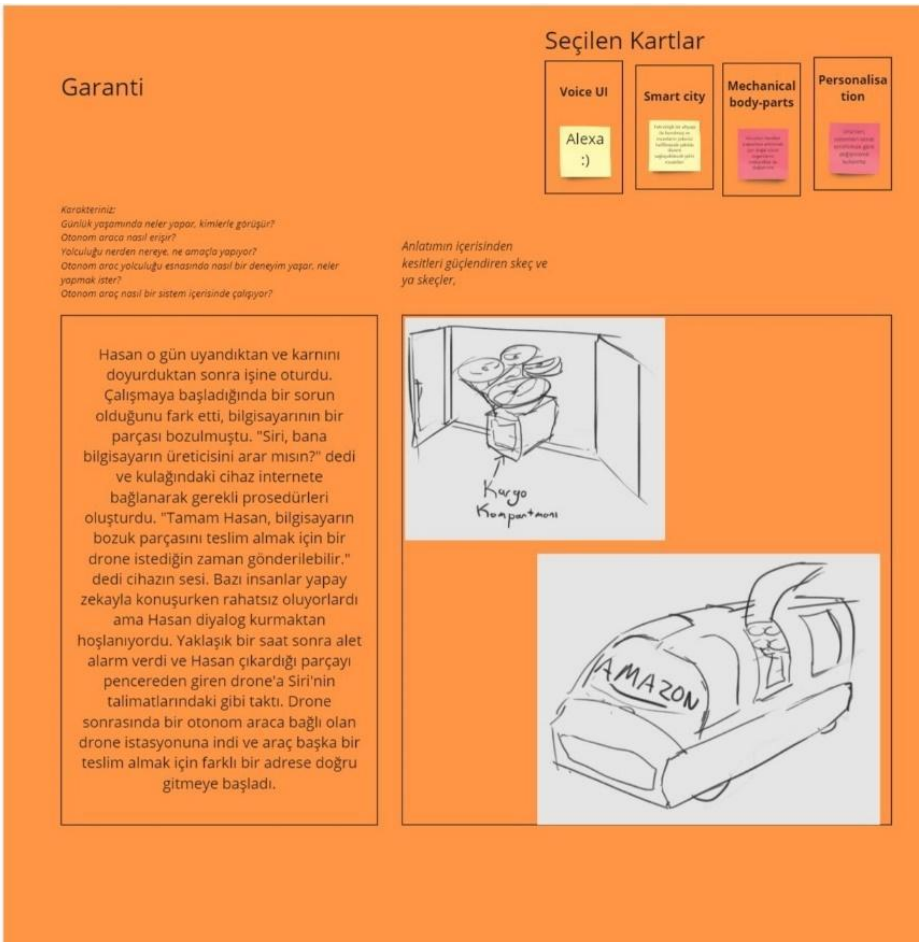

Figure 4.7 Sketches of flying AV in the Narrative-Scenario of W1P3

4.1.2.2 Usage Areas of AVs

There were different usage areas of AVs mentioned by participants, some of them are related to mobility while some depend on social values.

AV as an Office

W1P1 designed his AV as a moving office that the persona can set meetings and sleep if necessary. The participant used AR/VR to change the ambiance of the AV depending on its required function. The workaholic persona was occupying several sectors so the interior ambiance should be flexible. Also W2P1 and W2P4 considered using their AVs as offices. However, it was not their main focus in their scenarios. This idea has the potential of a design concept where the designer has a lot of different scenarios to work on. The main challenge can be creating a balance to change the environment physically and digitally together.

Events with AVs

W1P1 mentioned defining a space with multiple AVs. For example, an AV gamer party where each AV hosts a different game and allows people to socialize through their AVs. Even though it is just an idea, it is a very different perspective to look at AVs. Until now, all the ideas were structured in AVs' individual contexts. However, with this idea, it is possible that AVs can allow socialization. AVs for efficient space management can be another considered inspiration point. Since even AVs themselves are vehicles when they come together in different manners, they define space.

Traveling Long Distances with AVs

The freelance working persona created by W2P1 intends to travel around the world with her AV. The AV is an assistant as it was mentioned under the AV's Social Role title. However, the reason why it is worth discussing in this section is the participants' words "Traveling with Shared AVs". This idea reflects the possibilities that sharing AVs can reach within a worldwide context. Sure, there are

a lot of governmental barriers to eliminate but this can bring up an idea speculated on a storyworld where the world becomes a united nation.

Public AV

By looking at the outcomes, it is meaningful to look at public AVs from two different perspectives, mainly considering the number of users. It can be like a sharing taxi with few people or it can be like conventional buses with no driver. For example, while talking about the design of his public AV; W2P3 stated that he did not really think about interior design since he considered this public AV just a public bus with no driver. Of course, the motivation behind this approach is that his focus was on the transition process to AVs. On the contrary, W1P4 who designs a public AV on railroads defined new interactions for the users like brushing teeth, wearing make-up etc. Thus, it does not seem right to define public AVs as buses with no driver since the user needs have also been transformed.

AV for Delivery

Delivering products with AV is already a reality. However, some of the participants thought about how this idea can be adapted to the future. The issue of individuality and the increase in pet ownership have already been discussed in prior sections, and W2P2 proposed that there could be veterinary AVs to help the population of pets. The participant stated that pet owners do not seem to find time to fulfill their pets' needs when they are busy, so these specialized AVs can have a role in the future. Formerly, it was discussed that a half-human can be a user of AV and this time a non-human being is the user of AV.

Another possible use of AVs for delivery mentioned by W2P2 which is included in her scenario where the persona owns a vegan restaurant. The AVs' role here is being a food container and delivering the foods from the restaurant to the clients. In this scenario, the participant emphasizes the importance of AVs' food container

role as a design consideration. Thus, AV should be equipped to keep the food at the required temperature. In this scenario, the AV belongs to the restaurant but it is also possible to see the AVs owned by on-demand delivery services like *Getir* or *Trendyol.*

AV as a Living Area

In the previous sections like AV as an Office, AV for long travels; AV's purpose as a living area has already been discussed. However, in a different context, W1P2, considered the possibility of increasing capsule houses in the future and building on that, thinking about AVs as capsules opens up exciting scenarios. An AV apartment idea where the AV flats can park themselves and become a part of the apartment is discussed as another proposal for owning less space for parking AVs. This can be another smart city stereotype for the future.

4.1.2.3 Design

There were quite a number of design considerations mentioned by the participants throughout the workshops. Their diverse perspectives as designers allow them to look differently at the issue. They worked on different scales, different user groups in different storyworlds. Even though the design considerations were not detailed they might inspire designers who work on similar topics. Some of them have already been mentioned in the previous sections. However, there are some design considerations still left to discuss.

Interior Design

The design ideas related to interior design mainly arose from the extra time the user gains since he gave up the driving activity. The effect of ambient experience and AR/VR technology on the interior design of AVs seems to be inevitable. Ideas like

“office AV”, “AV as a living area” that were mentioned earlier are based on this technology. The main point of these designs was the flexibility of ambiance and perception. With AR/VR and ambient experience technologies, this flexibility magnifies and makes the user feel in a different space. Moreover, they can combine this with AR/VR for deeper experimentation. About that, it is beneficial to remember W2P4s’ words “The actual journey starts after the user gets off the AV. Because when she (her persona) is inside of it she doesn't feel like it is a journey, it is like a simulation.” Hence, the definition of journey ought to change with AVs, and one of the pioneers of this change will be ambient experience and AR/VR.

There were some proposals on the design of physical attributes. For example, W1P2 thought about an advertisement area or panel inside of a sharing AV, since this is similar to public transportation.

W2P4 mentioned the personalization of AVs and this makes sense since her AV is an owned one. However, W2P1 declared that her sharing AV design is personalizable and, according to her design idea the way to execute this is through AR/VR technology. She stated that the ambiance change is more important than changing physical attributes, “The persona can set standards for her own taste of journey, she can even set the voice of AI to feel like home.” This perspective seems valuable to design personalizable sharing AVs.

Exterior Design

There were some enjoyable topics to discuss on the exterior design of AVs. W1P3 pointed out the possibility of a symmetrical design on two axes for AVs with a route system that allows the vehicles just to move backward rather than turn around. W1P2 designed a vehicle that can both fly and move on the ground and the vehicle has 360 degree rotating wheels so that the vehicle's body does not change its direction when it is needed to rotate.

Some participants questioned the existence of physical attributes such as front windows and side mirrors. W2P4 proposed to use the front window as a mirror for

his persona, while W1P3 mentioned using side mirrors for different functions or eliminating them. There is not an accepted design typology for AVs yet. Thus, this kind of interrogations for non-AVs may help eliminate unnecessary elements for the exterior design of AVs.

4.2 Outcomes Related to the Workshop Format

Two workshops were organized one month apart as the fieldwork of the thesis. At the end of both workshops, a discussion session was held and the collected data is used to improve workshop formats. To experiment with that, changes have been made to the format for the second workshop depending on participant views.

4.2.1 Outcomes Related to the First Workshop Format

Brainstorming

General world issue titles which are *Politics, Economics, Social Life, Transportation, Environment and Technology* are given to participants to ease the mapping process. This led participants to think about the given areas in order. For example, W1P1:

> [5] For politics, that was the only thing that came to my mind. For economics, I think we will have free transportation to everywhere, I don't think this will be difficult. There is a dynamic mechanism and this can be beneficial for not only transportation but also other issues. For social life, since vehicles are more comfortable they might be a part of activities. Maybe something about education, not so many things come to my mind for social life. And technology, of course self-drive. It will be available before 2040 but by that time it will be very settled into the world. (W1P1)

As it is seen, W1P2 explains things following the order of the titles that are given. This was pretty much the same for all participants. It is not easy to understand whether this limits their opinion or eases their way of thinking since there are no other workshops to experiment on.

Another issue was the year given as 2040 to participants to build their storyworlds on. For example,

> [6] 2040 seems too close. If it would be a little bit more away, I could fantasize more. Because I don't think that there will be radical changes after 20 years. This situation limits my imagination a little (W1P3).

After this opinion W1P2 also agreed with him and W1P4 came with advice. She proposed defining a year interval rather than a definite year. However, W1P1 stated that 2040 is a late year for AVs to come and they would be here for 2040.

The final issue about brainstorming is the possibility of teamwork and participants collaborating from different fields. W1P2 proposed that brainstorming as a group from other fields would be more efficient:

> [7] Frankly, at the first stage, I thought, could it be teamwork, would it be more efficient if there was something like a designer lead in it? At least, maybe we could have done the first stage together as a group. Of course, this takes extra time but it can yield richer results. It would be even better if it was actually someone from other fields. Those from other fields may also create a disadvantage, hindering the freedom of producing ideas. So at least there can be close disciplines. Maybe regional planning, architecture etc. Apart from that, the first stage was good. Maybe you can increase the keywords here. And of course, if there is teamwork, the time can increase to 10 minutes. (W1P2)

After that opinion, W1P3 also stated that teamwork in brainstorming can be helpful and he also added that working with someone from a different field may add a larger perspective to the study.

Persona

In the discussion part, participants stressed the difficulty of drawing an image and the need for inspiration. Two participants used a ready-image from the web, while two others did not put an image for their persona. A robot-like avatar visual is used as a default image to indicate where to put the persona image (Figure 4.6). Seeing this image, participants stated that a visual or visuals like in Figure 4.6 would be helpful for them.

Figure 4.8 W1P2's persona

Narrative-Scenario

Narrative-Scenario is the phase where everything is put together as a final step. For that reason, participants stated that they enjoyed this step and they found the inspiration cards very helpful. Two participants stated that there could be another step to focus more on scenarios or increase their sketches and two participants complained about time restrictions.

4.2.2 Interventions to Second Workshop

Based on the participants' views, some interventions were made in each phase to increase the workshop's efficiency. Figure 4.7 shows these interventions step by step.

Table 4.1 *Interventions to the second workshop format*

	Workshop 1	Interventions	Workshop 2
Brainstorming	Individual- 5 min	*turned into a collaborative work with one common board*	10 min
Short presentation+discussion	10 min	10 min	10 min
Persona	10 min	*Avatar images given as an option instead of drawing or finding them online*	15 min
Short presentation+discussion	10 min	10 min	10 min
Narrative	20 min	*separated into two steps to see the distinction between them and encourage them to produce visual outcomes for the scenario part*	10 min
Scenario			15 min
Short presentation+discussion	25 min		25 min
Overall Discussion	20 min		15 min

For the brainstorming part, rather than a definite year 2040 to work on, an interval (2040-60) is given to participants. During the brainstorming in the first workshop,

participants worked on their own individual boards. However, a common brainstorming board is created for the second workshop.

For the persona part, only minor changes were made. Considering participants' views on producing persona visuals, they found it difficult in the first workshop, a set of visual avatars was given to the participants. It was inevitable that this would limit their imagination but also it could eliminate the frustration of drawing even if they had not been forced to do it in the first workshop. The inspirations for the avatar designs mostly come from various future characters from movies and books.

For the narrative-scenario part of the second workshop, the phase has been separated into two as narrative and scenario. In the previous version, the participants could build their scenarios by combining visuals and text. However, the first workshop participants stated that they could not focus on product scenarios in this format. Thus, this part was divided into two steps which are narrative and scenario. There is no visual outcome required for the narrative part and for the scenario part they were asked to work more visually (Figure 4.8).

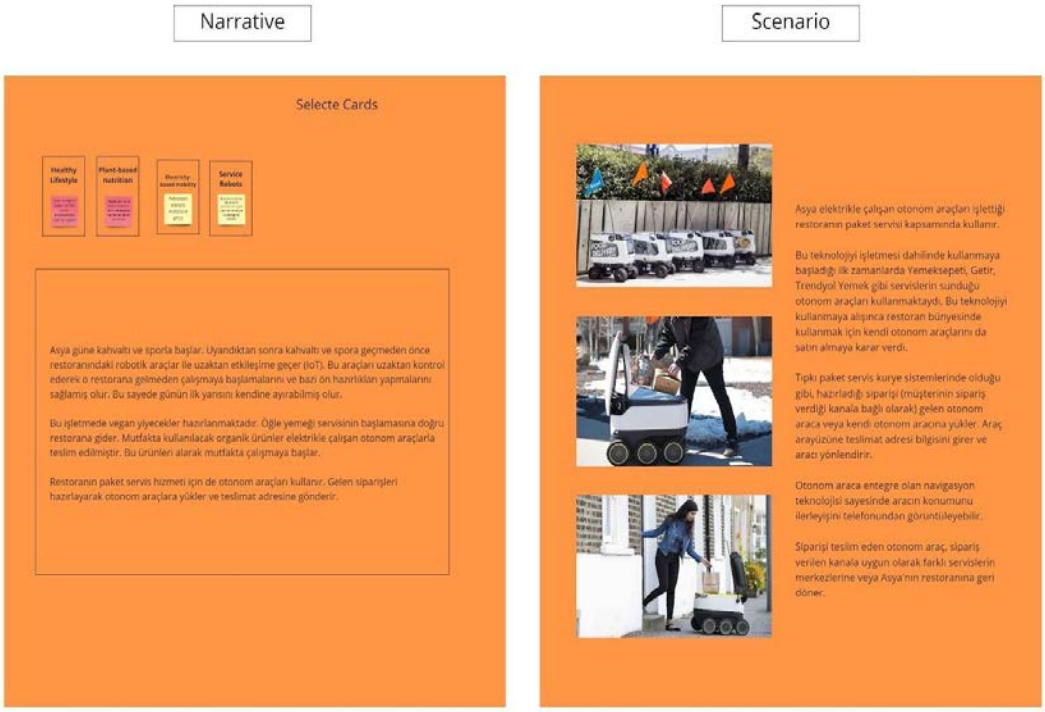

Figure 4.9 Narrative and Scenario of W2P2

For the discussion part of the second workshop, the focus points were different. About the impact of interventions, observations will be shared.

4.2.3 Outcomes Related to Second Workshop Format

First of all, a common brainstorming board was used in the second workshop. There was a possibility that this collaboration could create frustration since the participants do not know each other. Two participants from the workshop declared that this collaborative thinking inspired them for new ideas.

For example,

> [8] I actually thought about digital alternative payment systems as W1P4 said. Between economy and transportation, what comes to my mind when W1P1 writes minibuses is the transformation of public transportation vehicles into autonomy. This concept came to my mind. Then I thought of

the automation of cargo postal services and logistics services, which was the simplest thing that came to my mind first. (W1P3)

This actually shows that participants impacted each other to think differently. Thus, it can be said that collaboration for brainstorming had positive outcomes. However, there were fewer keywords but more sentences compared to the first workshop and the participants asked for an additional time a couple of times (Figure 4.9). This can be a further discussion point on whether brainstorming for design fiction should be built from keywords or sentences.

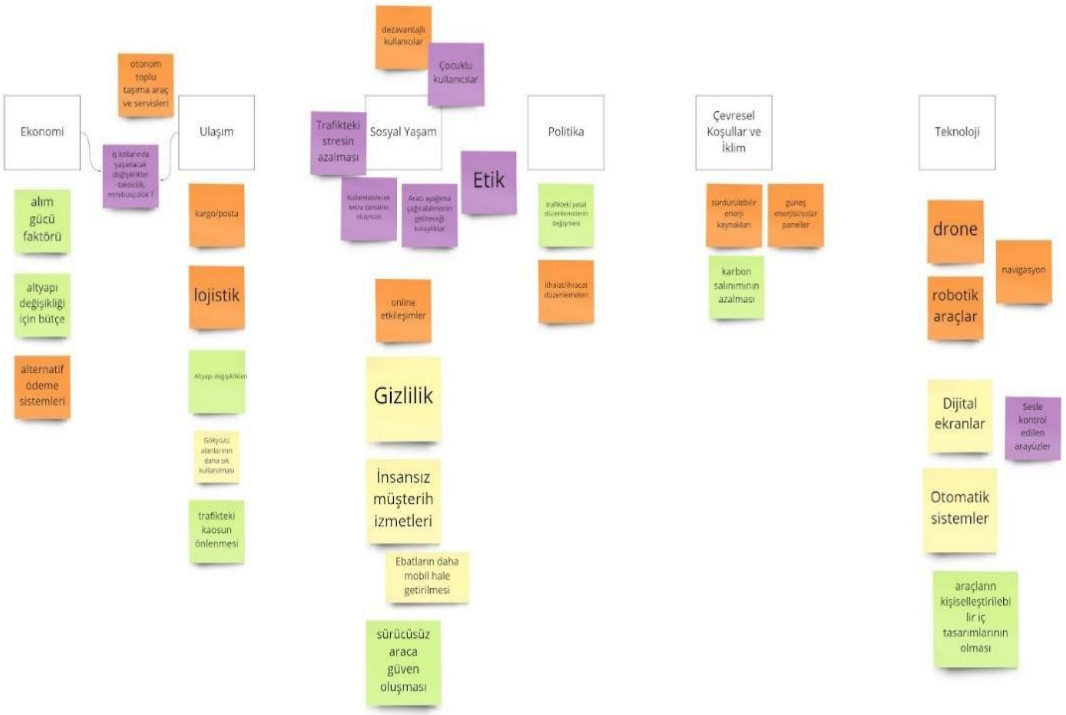

Figure 4.10 Brainstorming of the second workshop conducted as a team

The revision for the persona part was the addition of various avatar images. Three participants used the avatar images, while one of them used an image that she found online. Only W2P4 directly mentioned the image she used:

[9] Of course, I don't know if it will happen in the future in a digital world that contains so much radiation, but in a world with radiation, it seems like a world that will go for a special

> outfit and accessory will also develop. That's why I chose a figure with a helmet, glass and a little more closed and personalized, from the figures you gave us. (W2P4)

W1P4's scenario is mentioned several times in Section 4.1 and the persona image that she has chosen matches her scenario. Other participants mainly related their persona image choices with its age interval and possible appearance. For instance, W1P1 found the image online since she wanted to show that her persona is a traveler and needed a happy traveler young woman image.

The narrative-scenario part was separated into two different sections for the second workshop. The main difference here was all participants really created a scenario that includes AVs. Even though two participants stated that they could not really understand the difference between the two sections, they applied the procedure well. Other than that, no one used sketching in this workshop whereas, in the first workshop, everyone had used sketches. In the second workshop, participants had more time management problems. For example, a good sketcher W1P3 stated that normally he would like to sketch but thinking about narratives and scenarios took a lot of time, hence he could not find time to sketch.

4.3 Outcomes related to the Participant Strategies

After the workshop, it is observed that participants improved different strategies to complete the study. By analyzing these strategies, the workshop format can be improved for better outcomes.

Two different participants from both workshops were not satisfied with their outcomes since they were negative scenarios. One of them tried to change it into an optimistic scenario and the other one proposed the possibility of separating outcomes as positive and negative, especially for the brainstorming part. In a broader study, this can be considered to improve or diversify the scenarios. The participants might be asked to create a reverse scenario that may produce diverse results.

There were some designerly reflexes that some participants performed during the workshops. For example, W1P4 focused on the system design of her scenario-narrative and did not elaborate on the AV design. However, she drew how the system would work and explained it as a design scenario. In that case, separating narrative and scenario parts impacted participants' strategies. Three of four of the second workshop participants used images and described their scenarios which were similar to design scenarios. W2P3 also considered designing the routes that AV would pass and created a public transportation design idea that does not include intricate routes. Thus, it can be deduced that designers do not just create a narrative or scenario they also base their ideas on a realizable track as a reflex.

Participants followed different paths while creating their personas. As it was mentioned before, W1P1 built an office AV scenario. W1P1 actually started to create his persona and narrative while brainstorming since he directly mentioned using AVs as an office during this phase. He thought about the office AV concept first and created a persona that would use this AV. On the contrary, W1P4 stated that she was inspired by a movie while creating her persona. Thus, she indeed had a persona in her mind and she designed her AV based on this persona's wishes and needs. These two different examples show how reverse approaches designers had during the workshop. The discussable issue here can be the order of activities; which strategy works more efficiently, creating a persona for an existing AV concept or creating an AV concept for an existing persona? This might change based on the design fictions' purpose. Both of these activities can be considered as design fiction; what is aimed here is building a scenario. Thus, the person who is going to use these scenarios as an inspiration source may decide on this. If his primary purpose is product design, his focus should be on AV itself. However, if his main goal is to produce a game scenario, he may focus more on the product itself.

Some participants such as W2P1 and W1P4 were very good at adapting their persona and AV to their storyworlds. Their storyworlds had more detail; thus their persona and scenarios were more justified compared to the others. For example, in

W1P4's scenario, AVs are remotely controlled by the government and her persona is an officer who works in one of these control rooms. W2P1`s persona is a creative worker who travels around the world while working and she matches this also with the maximum capacity of creativity of her persona.

Sketching was also planned to be a part of this study and it was one of the ideas behind choosing the workshop participants as designers. When it comes to using sketches, there is an apparent difference between the workshops. While all the first workshop participants sketched something, none of the seconds drew anything but they preferred to use ready images to portray their scenarios. One of the reasons behind this is the workshop dynamics which is mainly related to the herd mentality, and participants were influenced by their peers when they saw each other sketching on Miro. Other than that, observing what the participants produce as sketches is interesting because four participants viewed it from three different perspectives. W1P4 drew her system on a regional scale on a city plan, W1P1 demonstrated the interior design of his AV and; W1P2 and W1P3 sketched their AVs' exterior appearance in a scenario. Participants were not directed about what they had to sketch; they were just asked to create a scenario combining text and visuals. Thus, this actually reflects how they approach the workshop. W1P4 focused on system design and she reflected on it, W1P1 directly focused on AV from the first phase and he gave details about the AV itself. The other two tried to reflect the interesting part of their scenario through AVs' exterior look.

Inspiration cards were a significant factor throughout the workshops. For example, W2P2 directly stated it was challenging to find an inspiration source in the first two phases which does not include AVs. Moreover, W2P3 affirmed that inspiration cards were very eye-opening for his future vision. The reason behind not giving inspiration cards in the first two phases was not to limit their imagination. However, this can be reconsidered since some participants rethink their fictional worlds after seeing inspiration cards; hence giving the inspiration cards in the beginning may help researchers to work on a safer ground in terms of results.

CHAPTER 5

CONCLUSION

There are two aims of this study;

- to discuss potential ideas for the design of future AVs considering the contextual and social changes
- to evaluate the guidance of design fiction methodologies during the process of envisioning future transportation.

In accordance with this purpose;

First, a literature review on future mobility, innovations and vehicle technologies; and future mobility scenarios was carried out in order to provide a background knowledge to perform the field study. Moreover, to strengthen the field study; design fiction and future scenario creating methodologies were analyzed (see Chapter 2).

Secondly, a field study, consisting of two online design fiction workshops with designers, was conducted to build future scenarios that include AVs (see Chapter 3).

Finally, the results of the field study were analyzed, comprehensive findings of the study were demonstrated, and important points that intersect with the literature review were identified. (see Chapter 4).

This chapter, firstly, includes the presentation of the research questions answered by examining the literature review and field research findings. After that, the

limitations of the study and opportunities for further research were addressed, and finally, contributions of the study were mentioned.

5.1 Revisiting the Research Questions

As explained in the introduction (Chapter 1), there are two main research questions:

- What are the characteristics of potential ideas for the design of future AVs considering the contextual and social changes?
- How can design fiction methodology guide the process of envisioning future transportation?

These questions will be answered below respectively.

What are the characteristics of potential ideas for the design of future AVs considering the contextual and social changes?

The main reason for creating a future storyworld with AVs was to contextualize the possible narratives that were going to consist of AVs. However, these storyworlds also support AV-based narratives. Moreover, participants started to bring different issues while creating their narratives in their AV-based world. For this reason, the outcomes were categorized under two headings: *Features of AVs* and *Storyworlds with AVs* (Figure 5.1). While answering this question, the strategies of the participants will be explained as well. Dunne and Raby (2013) state that speculative design is "a catalyst for social dreaming" and "to propose is at the heart of it". Also, the conclusions of this thesis create interesting areas for discussions and debates, hence the researcher provoked and interrogated the results through re-asking what-if questions in the conclusion part.

In the *Storyworld with AVs* part (Chapter 4.1.1), storyworld aspects that are mentioned by the participants were discussed. Actually, what was discussed during the brainstorming was meant to create the social and contextual background for

AV-based narratives and scenarios. The participants speculated on AVs' existence by creating scenarios including them.

Seeing AVs' adaptation in storyworlds through different personas demonstrated how AVs can affect people's daily lives as well as what kind of role AVs can have in future scenarios (Table 5.1). In the workshops, there was a diversity in the contents of outcomes. During two workshops with eight participants, all participants produced diverse storyworlds, personas and AV scenarios. In Table 5.1 it is seen that each participant produced a different concept vehicle within their scenarios and in each participant's scenario there was a different future context to be conveyed with AVs. Some of them created a system including AVs while others focused on the AV as a physical product. More details with respect to the table will be discussed as an answer to research questions. Before performing the workshops the extraction from literature demonstrated what kind of outcomes these scenarios could have (Figure 2.8). Hence, it was not surprising to see scenarios including sharing services, public AVs etc. With respect to Figure 2.8; areas like sharing, transportation mode and private/public vehicle are added to Table 5.1.

Table 5.1 *Summary of the participant scenarios*

Features of Scenarios/Participants	W1P1	W1P2	W1P3	W1P4	W2P1	W2P2	W2P3	W2P4
Future Context	Remote working	Diversity	Individuality	Controlled life	Remote working	Consumption practices	Transition process	Radiation and individuality
Concept	Office AV	Transportation system for an autonomous city	Shopping delivery system with AV	no pleasure of driving yes pleasure of reaching	work and travel AV	Food Deliverer AV	Autonomous Bus	Travel friend AV
Private/Public	Private	Public and Private	Private	Public	Private	Owned by restaurants	Public	Private
Sharing	owned by user	owned by Government, company or user	owned by Cargo Company	owned by Government	Yes	No	No	No
Transportation mode	on the ground	flying, floating, on the ground	flying	railroad	on the ground	on the ground , flying	On the ground	On the ground
System/product	Product	System	System+Product	System	System+Product	System+Product	System	Product
Social Role	Business meetings and living area	Design for socialization and living areas	User does not own and use the AV himself	Efficient time spender	user assistant	only business-related interactions with user	better regional planning and sustainable lifestyle	user friend
Prominent Technologies	AR/VR	Mechanical body parts	smart home, AI	Connectivity	AI, Voice UI	smart home, AI	3-d printing	AI, Voice UI

Characteristics of Storyworld with AVs

AVs' existence affected social life in different manners in the future storyworlds. The cases changed with the aspects of storyworlds that were defined by the participants. Having AVs in their life may push people to adopt new lifestyles or they might adopt AVs to improve their daily life. In the workshops, prominent lifestyles were individual, immobile, diversity-based and nomadic lifestyles. W1P3 declared that with the more technology involvement in our lives, the lonelier we will get. According to that, his persona works remotely and never gets out of his house. At home, he has an AI assistant and he does shopping through deliveries. That is where the AV comes into the scenario. Thus, it can be said that the persona is able to continue with the individual and immobile lifestyles through the AVs' existence. On the contrary, nomadic lifestyle relies on the direct interaction of AV and the user, since the vehicle both carries and accommodates the participant in

necessary situations. There were two approaches to this lifestyle based on the intimateness dedicated to AVs: keeping it as an assistant or assigning it as a friend. Just like in the scenario of the immobile lifestyle, assigning AV as a friend is an expected result with the combination of the individual lifestyle and nomadic lifestyle. However, this mainly depends on the needs and wishes of the user. In the future, it is even possible to see slave AVs considering the attitudes we have on products. Another lifestyle to mention is the production of W1P2: diversity-based lifestyle. AVs are able to increase the potential of mobility for everyone and subsequently, it can ease communication even more. He stated that with the increase in cultural diversity and blending of different cultures through the existence of AVs, people might start to have multi-cultural networks. On an exaggerated level, this idea may lead to one common nation utopia that is able to contain different cultures and languages. All of these lifestyles rely on extending the capacity of personal mobilization except immobile lifestyle. However, the realization of immobile lifestyle requires a proper connectivity system and service design, and AV is the key part of that system.

Changes of working habits were widely considered in the workshops. In some of the scenarios, the rise of remote and freelance working affected personas and their relations with AVs. For instance; W1P1's persona, a workaholic, has a specific AV that allows him to use it as an office. He can arrange meetings in AV using its AR/VR features. Similarly, another remote working persona was created by W2P1. In her scenario, she defined AV as an assistant in daily life and a secretary at work. Her persona is working freelance while traveling the world and she does that using a sharing service. She uses sharing AVs during her world tour and personalizes them. Thus, AVs enable people to adopt new working habits and these scenarios also show how AVs can be context specific based on their owners' interests. Personalization of AVs can be another issue that was derived from these scenarios. Especially, personalizing shared AVs is an interesting issue considering the difficulties of responding to different user needs on the same product. Other than that, when most of the vehicles in the world will be AVs, AVs will not be a type of

vehicle anymore. Thus, it is possible to see AVs categorized as office AV, long travel AV etc. based on their function. Moreover, it can also be more specified as it is mentioned before like slave, friend or assistant AV regarding the relation of the user and the product. This might even be reflected on the design of these products. Thus, a question can be asked; should AVs be defined in a meaning that is closer to vehicles or its specified context and function. Subsequently, should their design continue with the existing vehicle typology?

Another issue that was considered by participants was emerging and disappearing job areas in their future storyworlds. Inevitably, giving up the driving activity to AI; the driver jobs may be transformed into something else or entirely disappear. For example, W1P4 defined that some people work as remote controllers of public AVs in her government-controlled world. That can be an example of how driver jobs can be transformed. This job area might be handy for systems of restaurants or public transportation. Additionally, in the vegan restaurant of W2P2 all the delivery services were working with AVs. This may again bring the issue of the lost job as a delivery vehicle driver. Moreover; with the involvement of AI in daily life, other job areas will also be affected and this situation affected W2P1's persona to be defined as a creative worker since other jobs can be more easily replaced in the future. This has actually already started to happen. The job areas that are rising are actually preparing AIs to replace humans. However, how creative AIs themselves may become is still an discussable question.

Consumption practices have already started to change in daily life and what is witnessed with the current delivery services such as *Getir* is a transition process. In the future, with the lifestyles defined through AVs, this may be completely replaced. A few participants mentioned 3-D printers' extended role in the future of consumption behavior. Especially; W1P3 who designs his AV as a delivery vehicle mentioned the user's possibility of purchasing online products and printing them at home. Consumption behavior may not be directly affected by AVs' existence but they definitely support the vision of a more immobile life. Other than that; Holmberg, et al. (2016) states the power of mobility services to change

transportation from an ownership-based activity to consumption-based activity. This might be the case for the shared vehicles considering the temporary relationship of the vehicle and user that is created by sharing services. When the user owns the car, emotional bondage is created. However, when it is used only as a part of a journey, the user consumes the journey and the vehicle becomes just a tool.

Findings of the study address that in the storyworlds it is possible to see more humanized products as well as more robotized humans. Participants created cyborgs as personas and defined symbiotic relations with products, communicating with them more humanly. Thus, it can be deduced that as the products get smarter the meaning of human-product interaction is changing. Furthermore, humans have started to interact with products similar to the way they do with humans since they can communicate with products through talking, gestures, and touching. In a way, designers lead this behavior by adding anthropomorphic cues to the products. However, thinking the other way, humans are also being attracted by products. Their impeccable mechanism and speed may create situations where humans deliberately replace their body parts with mechanical parts.

The discussion around the storyworlds of participants included the issues of future interfaces. It is revealed that interfaces will be involved in every step of future life but there will be minimal interfaces as they become more cognitively functional in the future or it can be explained as the outcome and definition of interface ought to change. It is possible that digital interfaces may be replaced with cognitive interfaces. This issue can also be related to future designers' skills and mindset since social skills are replacing visual skills.

Characteristics directly related to AVs

The world-building process through AVs directed participants to question AVs' existence. Of course, the idea of self-driving cars is appealing and the main idea is to leave the driving activity to machines; and this would create extra time during the journey. Hence, the question transforms to how we can spend the extra time

created by leaving the driving activity to the machines. However, this is a very limited view and this study shows how AVs' existence may affect other things around.

Almost every participant, being aware or not, assigned a social role to their AVs (Table 5.1). In this case, it is felt that AVs' role as a transportation vehicle is fading. Instead, AVs become meeting areas or assistants to the users. This kind of social role takes AVs' place from a vehicle to an anthropomorphic object, which shows that AV is offering much more than replacing the driving activity.

In future scenarios, participants have tried to assign extra roles to AVs, knowing it is something more than a vehicle. Moreover, participants added extra usage areas other than their self-driving capacity (Figure 5.1) and except traveling longer distances they are not directly related to mobility. Thus, the outcomes demonstrate that AV's function as a mobile vehicle will not be the primary feature of the product. AVs will be defined through what other things it is capable of other than driving.

The issue of trust in AVs has been handled in different manners by participants. Results of the study show that the participants assigned anthropomorphic features to AVs. Even now designers put anthropomorphic features into car designs. However, the participants' approach was not transferring them visibly but mostly behaviorally. Kiesler and Goetz (2002) mention that anthropomorphism's most important element is not the humanly look and the examples related to this issue were already discussed in the conclusion part; such as AVs as assistants, friends etc. Actually, participants did not directly mention trust to AVs. However, when it is looked at the social relationships they build with and through AVs, these are all trust-related issues. Thus, they acknowledge trust through anthropomorphism. As Lee et al. (2015) state, visualizing information through anthropomorphism may affect users' trust in a positive way, which enables more opportunities for acknowledgement of AVs. Furthermore, AV was given human characteristics such as name, gender and voice in Waytz, Heafner and Epley's study (2014) and they

found out that participants thought the vehicle having anthropomorphic aspects were trusted more. It would not be surprising if they assign names and genders to AVs as their place in the world progresses.

When the discussion comes to the AVs' interaction design through personalization, the idea of transforming AVs' interior area was proposed by some participants. They all created ideas involving AR/VR technologies. Knowing the possibility of this technology allowed them to increase the usage flexibility of AVs. Another point of using AR/VR is changing the ambience of the interior and it was discussed the ambience's value for changing the feeling of an environment. For that reason, the vehicles that serve as both living and working areas came up. Pettersson and Karlsson (2015)'s study also supports the idea of AVs' interior as a living room and even though they did not mention AR/VR, their study also supports the idea of a transformative interior.

To reach the most efficient use of AVs, a proper infrastructure is a must. This issue was discussed in the literature from two different perspectives "something everywhere" and "everything somewhere" (Chan, 2017). Even though participants did not have the literature knowledge on this issue; they stated a need for total infrastructure transformation. However, they elaborated on possible solutions like creating new and separate routes for AVs. One of the reasons they designed flying, floating or railroad AVs is that they do not seem to operate on the ground with the current road systems. Thus, it makes it easier to adapt them to current cities when they do not use the streets. Although Metrobüs of İstanbul can be a good example for creating a new route for a public transportation vehicle, the routes where AVs fly or float sound more exciting. By speculating on these opinions, two different poles of regions can be structured based on the association level of the nations (Figure 5.2). First is a united world idea; in this world, nations are united and there is a common government. From a mobility-based perspective, this creates an opportunity to turn "something everywhere" to "everything everywhere", in which AVs spread everywhere (Tafidis et al., 2021). On the other pole the independent regions; in this world, the number of nations is multiplied and this creates broad

differences between the technology level of the regions. Thus, economically better countries can enable AVs with a proper infrastructure while others may not use AVs efficiently.

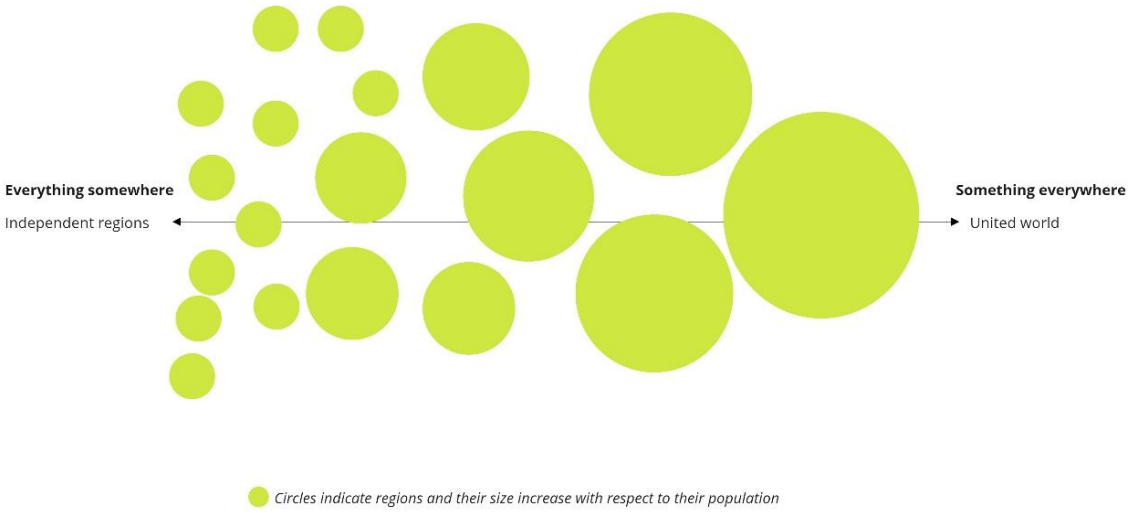

Figure 5.1 Two poles based on the association level of the nations

Almost half of the participants mentioned AVs' capacity of creating independent mobility for unlicensed people like the disabled. Litman (2017), mentions drunk personas can benefit from AVs as well. Furthermore, W1P3 mentioned kids and the elderly as possible new user groups. Even though none of the participants used these people as their personas, they mentioned this situation. AVs' characteristics will be affected by their user groups' tendencies as well. Hence their design should be modified to interact with these new user groups appropriately.

Another issue that can be extracted from the study is the expectation created on users' side. As it was mentioned and confirmed by participants, an AV image that comes to mind is a car. However, the study demonstrates that AVs do not have to move on the ground and some supported that it would have been easy to integrate them if they would not move on the ground. Thus, maybe more studies can be organized to change AVs' image as a car.

The discussion on AVs during the workshops and their analysis passed beyond the context of mobility. Their quality of carrying people left behind and the discussion went to other issues. About this, W2P4 stated a vital feeling:

“The actual journey starts after the user gets off the AV. Because when she is inside of it she doesn't feel like it is a journey, it is like a simulation.”

AVs’ integration into the world can change the meaning of journeys since AVs may reduce the perception of the journey and increase the idea that it is just a phase and there is a defined time that has to be passed. Furthermore, AVs’ existence will change the meaning of mobility for sure and it is possible that there is a need for new terms and transforming the old terms that are defined by today's mobility. Similarly, the definition of routes and streets was interrogated by the participants. AVs can sprawl the cities horizontally by creating faster and more enjoyable rides (Fulton, Mason & Meroux 2017). However, this study shows that AVs can also create vertical cities. For example, it can be assumed that there will be a time when people begin to consider traveling on air with AVs. However, today’s daily life does not include daily flying activities. The routes and streets should be modified according to that and there will be a need to create new regional definitions as well.

Participants stated and materialized design considerations on AVs during their scenario design processes. The design ideas related to interior design mostly arose from the user's extra time since he gave up the driving activity. These thoughts depended on ambient change which might also be a crucial point for the personalization of shared AVs. However, participants also considered physical design features like directing seats for more social or individual environments. On the exterior design part, whether AVs should have front and back sides were discussed. Especially if they had their own routes, this would give the vehicle the capacity to move backward without turning around. However, it might be problematic if they interact more with the pedestrians since they should understand which way the vehicle is going. Also, side mirrors’ existence in AVs was questioned. There is not an accepted design typology for AVs yet. Thus, these

kinds of interrogations through non-AVs may help eliminate unnecessary elements for the exterior design of AVs.

How can design fiction methodology guide the process of envisioning future transportation?

In this study, design fiction was applied through workshops and the idea of having AVs in the future was at the center of these workshops. Even though this study started from a vehicle's possible existence in the future, the areas it has been through show how design fiction deals with issues. With design fiction, the study passed beyond this and created lifestyles, habits, scenarios, systems, and products through the existence of AVs. The outcomes were not just about future transportation but derived from transportation issues and evolved into a part of storyworlds. Participants were asked to include AVs in their scenarios. Thus, everyone actually defined a mobility scenario for the future. Design fiction was very provocative in terms of creating future mobility concepts in terms of systems, products and interactions. The study started with a what-if question, what if we had AVs in our lives, and by asking that question the study explored not only the scenarios related to mobility but also the social life and environment which are affecting and being affected by these changes. This demonstrates that the fictional approach is working efficiently for imagining the contextual changes by reflecting the storyworld in which the scenario is happening.

There were different approaches to AVs' positioning within the personas' lives. For example, W2P4 owns an AV that sets it as a friend. In her narrative, the main issues are individuality and pollution-radiation and AV's reframed role is exactly a solution to these. Hence, AV is in the center of the narrative and the other issues were positioned around it. W2P1 does not own an AV, she uses sharing AVs to travel the world and work at the same time. Thus, in her life, AV is just a tool of progress.

On the other hand, W1P3 does not own or use AV directly. In his scenario, the cargo AV just delivers a product that the character ordered. However, even though

the narrative starts at personas' house it continues with the cargo delivery of AV. Then he explained some details about the design of the vehicle and how the delivery scenario processes. This reflex of participants actually demonstrates how this approach is able to create larger scenario inspirations. Moreover, it works just the way Coulton et al. (2017) state "(design fiction) narrates worlds not stories". The possible aspects of the worlds and some frames of the story world can be easily extracted.

Performing the study with designers is allowed to materialize the outcomes easily. Moreover, their capability and familiarity with creating scenarios affected the workshops positively in terms of time management. However, as it was discussed in the workshops, different participants from different backgrounds can enrich the results and improve the study. Examples of these can be engineers, architects or regional planners since the topics that were dealt with are close to these areas.

Format

Organizing and applying two workshops on design fiction, some observations and analyses about the workshop format were extracted. The workshops consisted of three parts: brainstorming, persona creation and narrative-scenario. Besides that, some interventions were made to the second workshop format based on the feedback given by the first workshop participants.

From an overall perspective, it can be observed that W1P4 followed a different strategy than other participants from the beginning of the workshop. She created a strong background for her storyworld; placed her persona and scenario with respect to that. For that reason, her storyworld has more details compared to the others and the storyworlds building process may start from a more extensive scale like in this example. Hence the brainstorming process could be structured in a way to emphasize this approach.

During the brainstorming in the first workshop, participants worked on their own individual boards. However, a common brainstorming board is created for the

second workshop. This seemed to have a positive effect on practical and collaborative thinking. Seeing each other's thoughts during their thinking process helped them enlarge their vision.

Designers are very experienced with creating personas and that was one of the advantages of that part. Even though they were encouraged to draw an image of the persona in the first workshop, they did not tend to draw and rather they asked for ready-images like an avatar. For the second workshop, they were given avatar images and this situation creates a limitation since the future personas can have very different appearances. However, they were more comfortable with their image selections and they explained the reason behind selecting those images. This issue could be handled differently. For example, rather than drawing an image of the persona; they could be asked to draw an accessory, cloth, gesture etc. belonging to that persona.

No one used sketching in the second workshop while in the first workshop everyone used sketches. For example, a good sketcher W1P3 stated that normally he would like to sketch but thinking about narratives and scenarios took a lot of time, hence he could not find time to sketch. Since the meetings were performed online other materialization methods like mock-ups, role-playing or performance could not be used and sketching was optional to not to create pressure on participants. However, it was observed that these materialization methods help to understand and improve scenarios, especially from a designer's perspective. Because even though the participants wrote the narratives at first when they are becoming scenarios seeing materialized cues enriches the study’s value.

5.2 Contribution of the Study

This study investigates future prospects including AVs and elaborates on them using scenarios and personas. Even though there are not directly manufacturable

products, there are a lot of concepts, behaviors and characteristics to be inspired from.

Firstly, the study explores the literature on different areas such as transportation design, speculative design, regional planning and interaction design. The combination of these study areas can be helpful for researchers that are searching for design futures. Designers, researchers and practitioners can benefit from this thesis as a source of knowledge and insights for related studies.

The study reflects design fiction's effectiveness for fictional scenario building in a specific context. Its use in transportation design and future mobility can trigger the ideation processes of product design teams. Moreover, not only design teams but also strategy departments of companies can apply this method through workshops by creating teams from different departments' members of the company. Other than that, game designers and concept designers can benefit from this method, especially in the ideation process and it can be repeated for the development of the products as well.

Jensen and Vistisen (2018) state that design fiction is used as a future strategy approach by global companies such as Microsoft and IKEA. Thus, this study can be enhanced to be an approach for deciding on future strategies of transportation companies.

5.3 Limitations and Suggestions for Further Studies

Several limitations were observed during different steps of the study. These were elaborated below.

As a result of this research, scenarios, personas, and aspects of the storyworlds were evaluated and various insights were introduced. For more in-depth data, a study focusing on only one of these issues can be conducted.

This study has a limited number of participants. Richer results can be achieved by performing with larger number of participants. In addition, the study was carried out through online meetings. Online meetings are difficult for collaborative studies and participants get bored easily in front of screens. Performing physical meetings can contribute to the analysis of more diverse features especially in terms of materialization of outcomes. Moreover, online meetings limited the observation capacity as well. It was not possible for the researcher to observe both the Miro screen and reactions for participants at the same time.

The study hosted designers as participants. Even though their participance creates lots of advantages, people from different backgrounds could enrich the study.

More workshops with more participants could create richer data and increase the diversity of the study. Also, more workshops with the same participants could be helpful for more detailed results. This was not the study's main point but detailed concepts can be produced using design fiction in the ideation process.

REFERENCES

ARUP (2017). *Autonomous, Connected, Electric and Shared Vehicles. Reimagining Transport to Drive Economic Growth.* Arup Group Limited. Retrieved from https://www.arup.com/perspectives/publications/research/section/autonomous-connected-electric-and-shared-vehicles

Alonso-Mora, J., Wallar, A. & Rus, D. (2017). Predictive routing for autonomous mobility-on-demand systems with ride-sharing. *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS).* pp. 3583-3590, doi: 10.1109/IROS.2017.8206203.

Auger, J. H. (2012). *Why Robot? Speculative design, the domestication of technology and the considered future.* (Doctoral thesis, Royal College of Art, United Kingdom). Retrieved from http://researchonline.rca.ac.uk/1660/1/Why%20Robots%20-%20Print.pdf

Auger, J. H. (2013). "Speculative design: Crafting the speculation*"*. *Digital Creativity*, 24(1), 11-35.

Bleecker, J. (2009). Design Fiction: A short essay on design, science, fact and fiction. *Near Future Laboratory*.

Bosch, T. (2012, March 2). Sci-Fi Writer Bruce Sterling Explains the Intriguing New Concept of Design Fiction. Slate Magazine. https://slate.com/technology/2012/03/bruce-sterling-on-design-fictions.html

Blythe, M., Andersen, K., Clarke, R., & Wright, P. (2016). Anti-Solutionist Strategies. *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems - CHI '16*. doi:10.1145/2858036.2858482

CAR, 2016. *The Impact of New Mobility Services on the Automotive Industry*. Center for Automotive Research.

Candy, S. & Watson, J. (2015). The Thing From the Future. https://situationlab.org, CC-BY-NC-SA.

Chan, C. Y. (2017). Advancements, prospects, and impacts of automated driving systems. *International Journal of Transportation Science and Technology,* 6(3), 208–216. https://doi.org/10.1016/j.ijtst.2017.07.008

Cheon, E., Sher, S. T. H., Sabanović, Š., & Su, N. M. (2019, June). I Beg to Differ: Soft Conflicts in Collaborative Design Using Design Fictions. In *Proceedings of the 2019 on Designing Interactive Systems Conference* (pp. 201-214).

Cho, J. Y., & Cho, M. H. (2014). Student perceptions and performance in online and offline collaboration in an interior design studio. *International Journal of Technology and Design Education*, 24(4), 473–491. doi:10.1007/s10798-014-9265-0

Choi, J. K., & Ji, Y. G. (2015). Investigating the Importance of Trust on Adopting an Autonomous Vehicle. *International Journal of Human-Computer Interaction,* 31(10), 692–702. https://doi.org/10.1080/10447318.2015.1070549

Coppola, P., & Silvestri, F. (2019). Autonomous vehicles and future mobility solutions. In P. Coppola & D. Esztergár-Kiss (Eds.), *Autonomous vehicles and future mobility* (pp. 1–15). Elsevier.

Coulton, P., Lindley, J., Sturdee, M., & Stead, M. (2017). 'Design Fiction as World Building'. *In: Proceedings of the 3rd Biennial Research Through Design Conference*, 11, 163- 179. doi:10.6084/m9.figshare.4746964.

Darby, A., Tsekleves, E., & Sawyer, P. (2018). Speculative Requirements: Design Fiction and RE. *In 2018 IEEE 26th International Requirements Engineering Conference* (RE) (pp. 388-393). (2018 IEEE 26th International Requirements Engineering Conference (RE)). IEEE. https://doi.org/10.1109/RE.2018.00-20

Dindler, C., & Iversen, O. (2007). Fictional Inquiry–Design Collaboration in a Shared Narrative Space. *CoDesign: International Journal of CoCreation in Design and the Arts*, 3(4).

Dunne, A., & Raby, F. (2013). *Speculative Everything: Design, Fiction, and Social Dreaming (The MIT Press)* (Illustrated ed.). The MIT Press.

Duffy, B. R. (2003). Anthropomorphism and the social robot. *Robotics and Autonomous Systems*, 42(3–4), 177–190. https://doi.org/10.1016/s0921-8890(02)00374-3

Dzindolet, M. T., Peterson, S. A., Pomranky, R. A., Pierce, L. G., & Beck, H. P. (2003). The role of trust in automation reliance. *International Journal of Human-Computer Studies,* 58(6), 697–718. https://doi.org/10.1016/S1071-5819(03)00038-7

Fagnant, D. J., Kockelman, K. M., & Bansal, P. (2016). Operations of Shared Autonomous Vehicle Fleet for Austin, Texas, Market. *Transportation Research Record*, 2563(1), 98–106. https://doi.org/10.3141/2536-12

Fulton, L., Mason, J., & Meroux, D. (2017). Three Revolutions in Urban Transportation: How to Achieve the Full Potential of Vehicle Electrification, Automation and Shared Mobility in Urban Transportation Systems around the World by 2050, *Institute for Transportation and Development Policy.* UC DAVIS, IDTP.

Futurice (n.d.). Lean Futures Creation Toolkit. https://futurice.com/lean-futures-creation-toolkit

Grand, S., and Wiedmer, M. (2010). Design Fiction: A Method Toolbox for Design Research in a Complex World, in Durling, D., Bousbaci, R., Chen, L, Gauthier, P., Poldma, T., Roworth-Stokes, S. and Stolterman, E (eds.), *Design and Complexity - DRS International Conference 2010,* 7-9 July, Montreal, Canada. https://dl.designresearchsociety.org/drs-conference-papers/drs2010/researchpapers/47

Gruel, W., & Stanford, J. M. (2016). Assessing the Long-term Effects of Autonomous Vehicles: A Speculative Approach. *Transportation Research Procedia,* 13, 18–29. https://doi.org/10.1016/j.trpro.2016.05.003

Grush, B., Niles, J., & Baum, E. (2016). Driverless Cars Ahead: Ontario Must Prepare for Vehicle Automation. RCCAO. http://rccao. com/research/files/RCCAO_Vehicle-Automation_OCT2016_WEB. pdf.

Hengstler, M., Enkel, E., & Duelli, S. (2016). Applied artificial intelligence and trust—The case of autonomous vehicles and medical assistance devices. *Technological Forecasting and Social Change*, 105, 105–120. doi:10.1016/j.techfore.2015.12.01

Holmberg, P. E., Collado, M., Sarasini, S., & Williander, M. (2016). *Mobility as a Service-MaaS: Describing the framework.* In Tuesday, February 16, 2016.

Jensen, T. B. F., & Vistisen, P. (2018). Strategic Design Fiction: A Plausible Reality & its Implications. *Akademisk Kvarter*, 17, 53-68. https://journals.aau.dk/index.php/ak/article/view/2510/198

Jensen, T., & Vistisen, P. (2017). Ethical Design Fiction: Between storytelling and world building. *In ETHICOMP 2017 Conference Proceedings: Values in Emerging Science and Technology* (2 ed., Vol. 1). https://doi.org/10.29297/orbit.v1i2.56

Kaplan, A., & Haenlein, M. (2019) Siri, Siri, in my hand: Who's the fairest in the land? On the interpretations, illustrations, and implications of artificial intelligence. *Bus. Horiz.* 62, 15–25.

Kiesler, S., & Goetz, J. (2002). Mental models of robotic assistants. *In Proceedings of the CHI '02 Extended Abstracts on Human Factors in Computing*. Association for Computing Machinery, New York (pp. 576–577). NY: ACM. DOI: https://doi.org/10.1145/506443.50649

Kirby, D. (2010). The Future is Now: Diegetic Prototypes and the Role of Popular Films in Generating Real-world Technological Development. *Social Studies of Science*, 40(1), 41–70. https://doi.org/10.1177/0306312709338325

Kraus, S., Althoff, M., Heißing, B., & Buss, M. (2009). Cognition and emotion in autonomous cars. In Intelligent Vehicles Symposium, 2009 IEEE (pp. 635–640). https://doi.org/10.1109/IVS.2009.5164351

Krueger, R., Rashidi, T. H., & Rose, J. M. (2016). Preferences for shared autonomous vehicles. *Transportation Research Part C: Emerging Technologies*, 69, 343–355. https://doi.org/10.1016/j.trc.2016.06.015

Kim, S., Chang, J. J. E., Park, H. H., Song, S. U., Cha, C. B., Kim, J. W., & Kang, N. (2020). Autonomous taxi service design and user experience. *International Journal of Human–Computer Interaction*, 36(5), 429-448.

Knutz, E., Ulv Lenskjold, T., & Markussen, T. (2016). Fiction as a resource in participatory design. In P. Lloyd, & E. Bohemia (Eds.), *Proceedings of DRS 2016 International Conference: Future–Focused Thinking* (Vol. 5, pp. 1830-1844). Design Research Society. https://doi.org/10.21606/drs.2016.476

Knutz, E., Markussen, T., & Christensen, P. R. (2014). The Role of Fiction in Experiments within Design, Art & Architecture. *Artifact,* 3(2), 8. https://doi.org/10.14434/artifact.v3i2.4045

Lee, J. D., & See, K. A. (2004). "Trust in automation: designing for appropriate reliance," *Human Factors*, 46, 50-80.

Li, X., Hess, T. J., & Valacich, J. S. (2008). Why do we trust new technology? A study of initial trust formation with organizational information systems. *Journal of Strategic Information Systems*, 17(1), 39–71.

Lindley, J. (2015). A pragmatics framework for design fiction. *In Proceedings of the 11th European Academy of Design Conference*

Lindley, J. & Coulton P. (2015a). Back to the future: 10 years of design fiction. *In Proceedings of the 2015 British HCI Conference (British HCI '15)*. New York (pp. 210–211). NY: ACM.

Lindley, J., & Coulton, P. (2015b). Game of drones. In CHI PLAY '15 Proceedings of the 2015 Annual Symposium on Computer-Human Interaction in Play (pp. 613-618). ACM. https://doi.org/10.1145/2793107.2810300

Lindley, J., Sharma, D., & Potts, R. (2014). *Anticipatory Ethnography: Design Fiction as an Input to Design Ethnography*. Ethnographic Praxis in Industry Conference Proceedings, '014(1), 237-253. https://doi.org/10.1111/1559-8918.01030

Litman, T. (2017). *Autonomous Vehicle Implementation Predictions*. Victoria Transport Policy Institute.

Lee, J. G., Kim, K. J., Lee, S., & Shin, D. H. (2015). Can autonomous vehicles be safe and trustworthy? Effects of appearance and autonomy of unmanned driving systems. *International Journal of Human-Computer Interaction*, 31(10), 682–691.

MacVaugh, J., Schiavone, F., 2010. Limits to the diffusion of innovation: a literature review and integrative model. *Eur. J. Innov. Manag.* 13 (2), 197–221

Marshall, M. N. (1996). Sampling for qualitative research. *Family Practice* (13), pp. 522-525

Markussen, T., & Knutz, E. (2013). The poetics of design fiction. In *Proceedings of the 6th International Conference on Designing Pleasurable Products and Interfaces* (pp. 231-240).

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. https://doi.org/10.1080/15472450.2017.1291351

Miles, J., & Walker, A. (2006). *The potential application of artificial intelligence in transport* (Vol. 153, Issue 3). Institution of Engineering and Technology (IET). https://doi.org/10.1049/ip-its:20060014

Mori, M., MacDorman, K., & Kageki, N. (2012). The Uncanny Valley [From the Field]. *IEEE Robotics & Automation Magazine,* 19(2), 98–100. https://doi.org/10.1109/mra.2012.2192811

Muir, B. M., & Moray, N. (1996). Trust in automation. Part II. Experimental studies of trust and human intervention in a process control simulation. *Ergonomics,* 39(3), 429–460. https://doi.org/10.1080/00140139608964474

Nägele, L. V., Ryöppy, M., & Wilde, D. (2018). PDFi Participatory Design Fiction with Vulnerable Users. *Proceedings of the 10th Nordic Conference on Human-Computer Interaction* - NordiCHI '18. doi:10.1145/3240167.3240272

Nikitas, A., Michalakopoulou, K., Njoya, E. T., & Karampatzakis, D. (2020). Artificial Intelligence, Transport and the Smart City: Definitions and Dimensions of a New Mobility Era. *Sustainability*, 12(7), 2789. https://doi.org/10.3390/su12072789

Niu, D., Terken, J., & Eggen, B. (2018). Anthropomorphizing information to enhance trust in autonomous vehicles. *Human Factors and Ergonomics in Manufacturing & Service Industries*, 28(6), 352-359. https://doi.org/10.1002/hfm.20745

Olson-Buchanan, J. B., Rechner, P. L., Sanchez, R. J. and Schmidtke, J. M. (2007). "Utilizing virtual teams in a management principles course". *Education + Training,* (49)5, 408-423. https://doi.org/10.1108/00400910710762968

Pettersson, I., & Karlsson, I. M. (2015). Setting the stage for autonomous cars: a pilot study of future autonomous driving experiences. *IET Intelligent Transport Systems*, 9(7), 694–701. https://doi.org/10.1049/iet-its.2014.0168

Papa, E., & Ferreira, A. (2018). Sustainable Accessibility and the Implementation of Automated Vehicles: Identifying Critical Decisions. *Urban Science*, 2(1), 5. https://doi.org/10.3390/urbansci2010005

Rakotonirainy, A., Schroeter, R., & Soro, A. (2014). Three social car visions to improve driver behaviour. *Pervasive and Mobile Computing,* 14, 147–160. https://doi.org/10.1016/j.pmcj.2014.06.004

Rempel, J. K., Holmes, J. G., & Zanna, M. P. (1985). Trust in close relationships. *Journal of Personality and Social Psychology*, 49(1), 95–112. https://doi.org/10.1037/0022-3514.49.1.95

Rödel, C., Stadler, S., Meschtscherjakov, A., & Tscheligi, M. (2014). *Towards Autonomous Cars.* ACM. https://doi.org/10.1145/2667317.2667330

SAE (2018). Levels of Autonomy. Retrieved from https://www.sae.org/standards/content/j3016_201806/ on 23 May 2020

Sivak, M., & Schoettle, B. (2015). *Road safety with self-driving vehicles: general limitations and road sharing with conventional vehicles.* Transportation Research Institute (UMTRI). https://hdl.handle.net/2027.42/111735

Smith, S. (2016). *Benefits Estimation for AV Systems*. 3nd SIP-adus Workshop. U.S. Department of Transportation https://en.sip-adus.go.jp/evt/workshop2016/file/evt_ws2016_s6_ScottSmith.pdf

Sterling B. (2005). *Shaping things.* The MIT Press.

Tafidis, P., Farah, H., Brijs, T., & Pirdavani, A. (2021). "Everything Somewhere" or "Something Everywhere": Examining the Implications of Automated Vehicles' Deployment Strategies. *Sustainability,* 13(17), 9750. https://doi.org/10.3390/su13179750

Thoring, K., Mueller, R., & Badke-Schaub, P. (2020). Workshops as a Research Method: Guidelines for Designing and Evaluating Artifacts Through Workshops. *Hawaii International Conference on System Sciences.* https://doi.org/10.24251/hicss.2020.620

Tirachini, A. (2019). Ride-hailing, travel behaviour and sustainable mobility: an international review. *Transportation*, 1-37.

Townsend, A. (2014). *Re-programming mobility: The digital transformation of transportation in the United States.* Rudin Center for Transportation Policy and Management: New York, NY, USA.

Transport Systems Catapult (2017). *Market forecast for connected and autonomous vehicles.* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/642813/15780_TSC_Market_Forecast_for_CAV_Report_FINAL.pdf

Trommer, S., Kolarova, V., Fraedrich, E., Kröger, L., Kickhöfer, B., Kuhnimhof, T., Lenz, B., & Phleps, P. (2016). *Autonomous Driving - The Impact of Vehicle Automation on Mobility Behaviour.* Institute of Transport Research. https://elib.dlr.de/110337/

United Nations, Department of Economic and Social Affairs, Population Division. (2017). *World Population Ageing 2017 - Highlights (ST/ESA/SER.A/3)*. United Nations. https://www.un.org/en/development/desa/population/publications/pdf/ageing/WPA2017_Highlights.pdf

Verberne, F. M. F., Ham, J., & Midden, C. J. H. (2012). Trust in Smart Systems. Human Factors: *The Journal of the Human Factors and Ergonomics Society,* 54(5), 799–810. https://doi.org/10.1177/0018720812443825

Waytz, A., Heafner, J., & Epley, N. (2014). The mind in the machine: Anthropomorphism increases trust in an autonomous vehicle. *Journal of Experimental Social Psychology,* 52, 113–117. https://doi.org/10.1016/j.jesp.2014.01.005

Yap, M. D., Correia, G., & van Arem, B. (2016). Preferences of travellers for using automated vehicles as last mile public transport of multimodal train trips. *Transportation Research Part A: Policy and Practice,* 94, 1–16. https://doi.org/10.1016/j.tra.2016.09.003

Zmud, J., Ecola, L., Phleps, P., & Feige, I. (2013). *The Future of Mobility: Scenarios for the United States in 2030*. RAND Corporation

APPENDICES

A. Consent Form (Turkish)

Araştırmaya Gönüllü Katılım Formu

Bu çalışma ODTÜ Endüstriyel Tasarım Bölümü yüksek lisans öğrencisi Abdullah Tarık Çelik tarafından Prof. Dr. Gülay Hasdoğan danışmanlığında yürütülen tez çalışması kapsamında gerçekleştirilmektedir. Bu form sizi araştırma koşulları hakkında bilgilendirmek için hazırlanmıştır.

Çalışmanın Amacı Nedir?

Araştırmanın amacı gelecekteki ulaşım senaryolarına üzerine spekülatif bir bakış açısı ile fikir geliştirmektir.

Katılımınızla ilgili bilmeniz gerekenler:

Araştırma yaklaşık iki saatlik bir ve ya iki çevrimiçi çalıştay oturumu olarak gerçekleşecektir. Çalışmaya katılmak gönüllülük esasına dayanmaktadır. Çalıştayı gerçekleştirmek için Zoom programı üzerinde toplanılacak ve Miro programı üzerinde fikir geliştirilecektir. Çalışmada sizin dışınızda da katılımcılar yer alacak ve ilk 45 dakikalık kısmı toplu etkileşim ile gerçekleşecektir. Çalışma esnasında sizden fikirlerinizi görselleştirerek aktarmanız beklenmektedir. Görselleştirirken kullanacağınız yöntem tasarımcı olarak kendinizi nasıl rahat hissettiğinize bağlı olarak size bırakılmıştır. Çevrimiçi oturum daha sonra değerlendirme amacıyla kullanılabilmesi için kayıt altına alınacaktır. Çalışmayı istediğiniz zaman bırakabilirsiniz.

Araştırmaya katılanlardan toplanan veriler tamamen gizli tutulacak, veriler ve kimlik bilgileri herhangi bir şekilde eşleştirilmeyecektir. Katılımcıların isimleri bağımsız bir listede toplanacaktır. Ayrıca toplanan verilere sadece araştırmacı

ulaşabilecektir. Bu araştırmanın sonuçları bilimsel ve profesyonel yayınlarda veya eğitim amaçlı kullanılabilir, fakat katılımcıların kimliği gizli tutulacaktır.

Araştırmayla ilgili daha fazla bilgi almak isterseniz:

Çalışmayla ilgili soru ve yorumlarınızı araştırmacıya Abdullah Tarık Çelik (atarikcelik@gmail.com) adresinden iletebilirsiniz.

Yukarıdaki bilgileri okudum ve bu çalışmaya tamamen gönüllü olarak katılıyorum.

(Formu doldurup imzaladıktan sonra uygulayıcıya geri veriniz).

İsim Soyad Tarih İmza

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Consent Form (English)

This study was carried out by Abdullah Tarık Çelik, a graduate student at METU Industrial Design Department, it is carried out within the scope of the thesis study conducted under the supervision of Prof. Dr. Gülay Hasdoğan. This form has been prepared to inform you about the research conditions.

What is the Purpose of the Study?

The aim of the research is to develop ideas on future transportation scenarios with a speculative perspective.

Here's what you need to know about your participation:

The research will take place as one or two online workshop sessions of approximately two hours. Participation in the study is on a voluntary basis. To perform the workshop, a meeting will be held on the Zoom program and ideas will be developed on the Miro program. There will be participants other than you in the study, and the first 45 minutes will take place with collective interaction. During the study, you are expected to convey your ideas by writing as well as visualizing. The method you use while visualizing is left to you depending on how comfortable you feel as a designer. The online session will be recorded so that it can be used later for evaluation purposes. You can stop working at any time.

The data collected from the participants of the research will be kept completely confidential, data and identity information will not be matched in any way. The names of the participants will be collected in an independent list. In addition, only the researcher can access the collected data. The results of this research may be used in scientific and professional publications or for educational purposes, but the identity of the participants will be kept confidential.

If you would like more information about the research:

You can send your questions and comments about the study to the researcher at Abdullah Tarık Çelik (atarikcelik@gmail.com).

I have read the above information and participate in this study completely voluntarily.

(After completing and signing the form, return it to the researcher).

Name-Surname Date Signature

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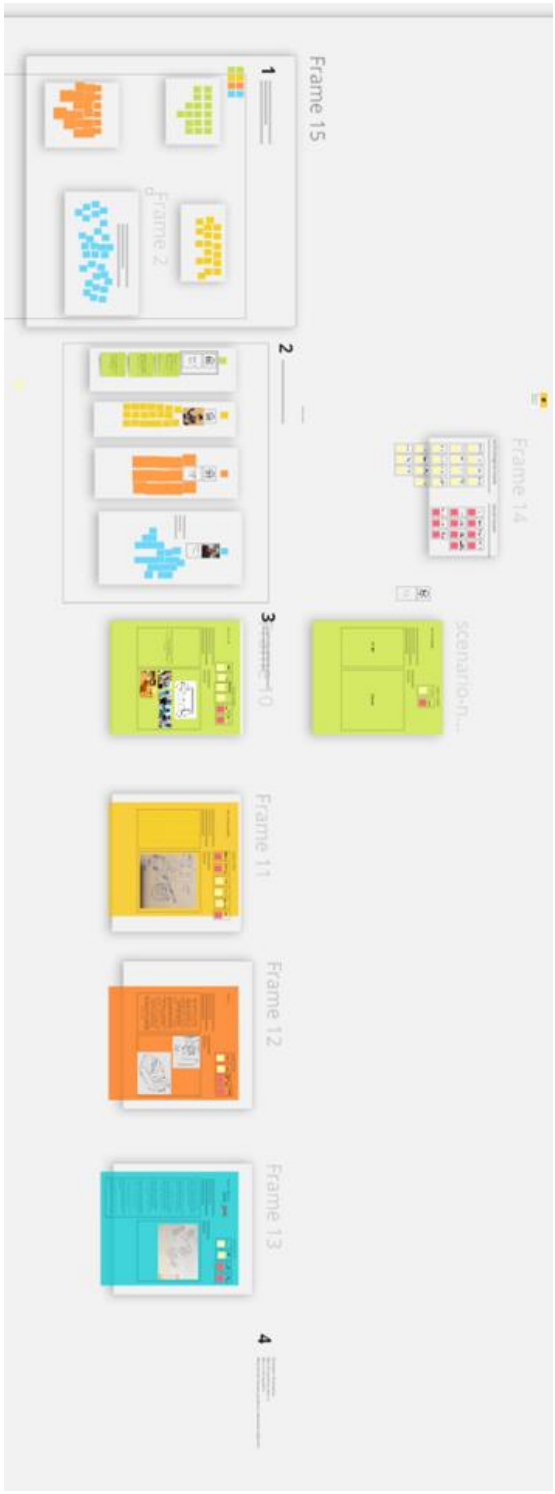
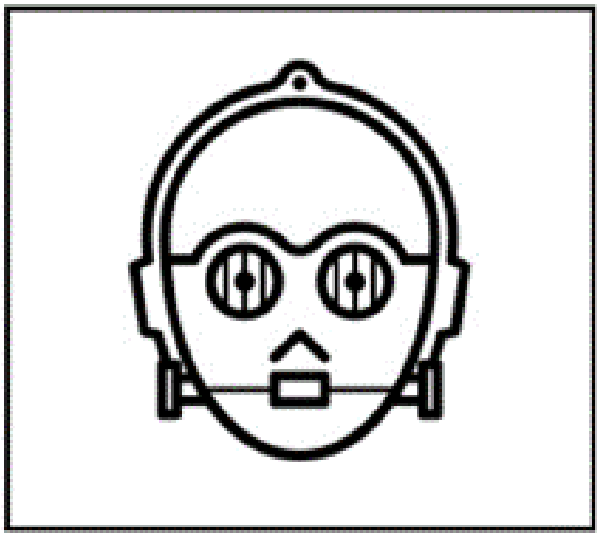
B. Workshop template filled by participants- Miroboard



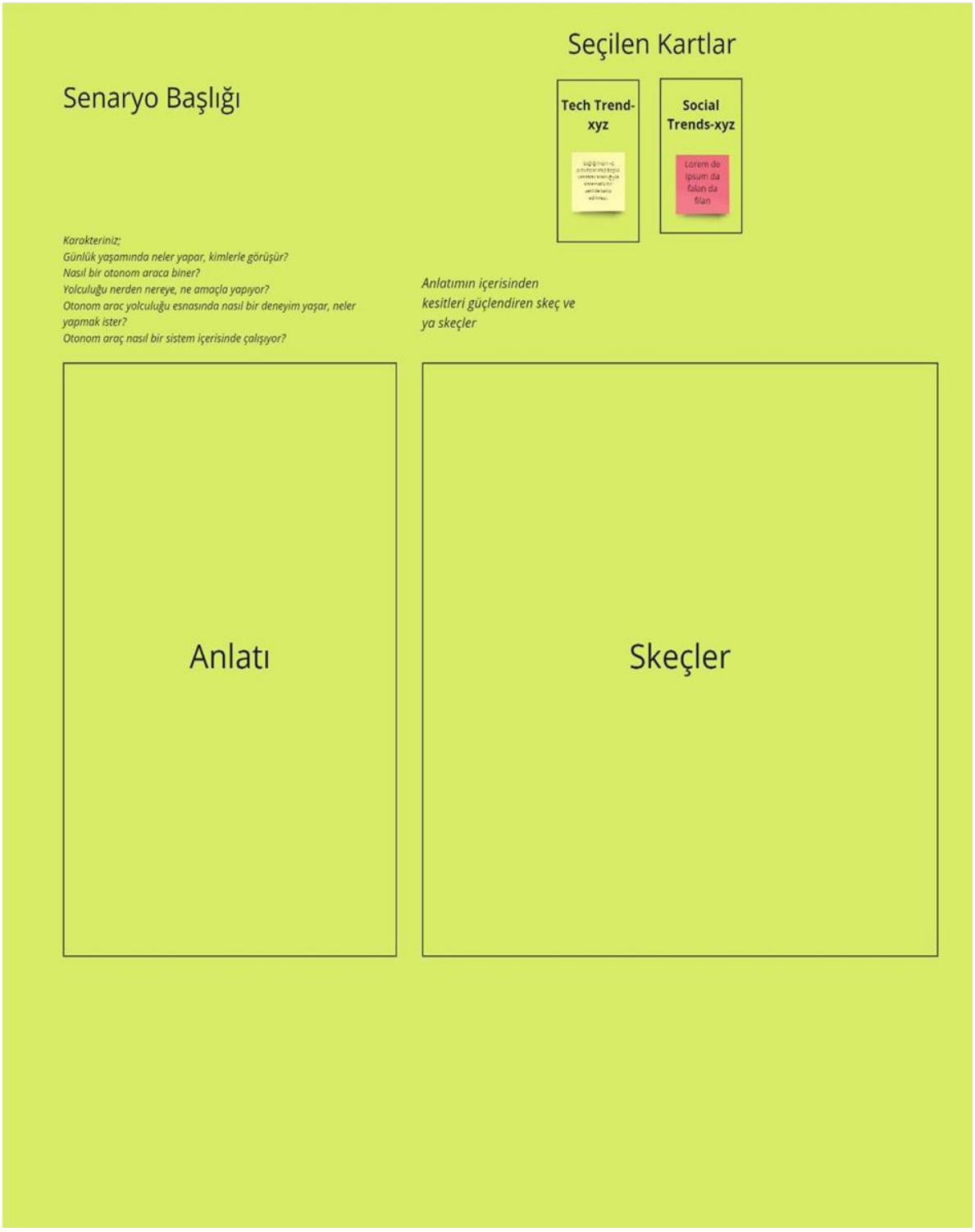
C. Brainstorming of W1P1 (Turkish)

D. Persona template (Turkish)



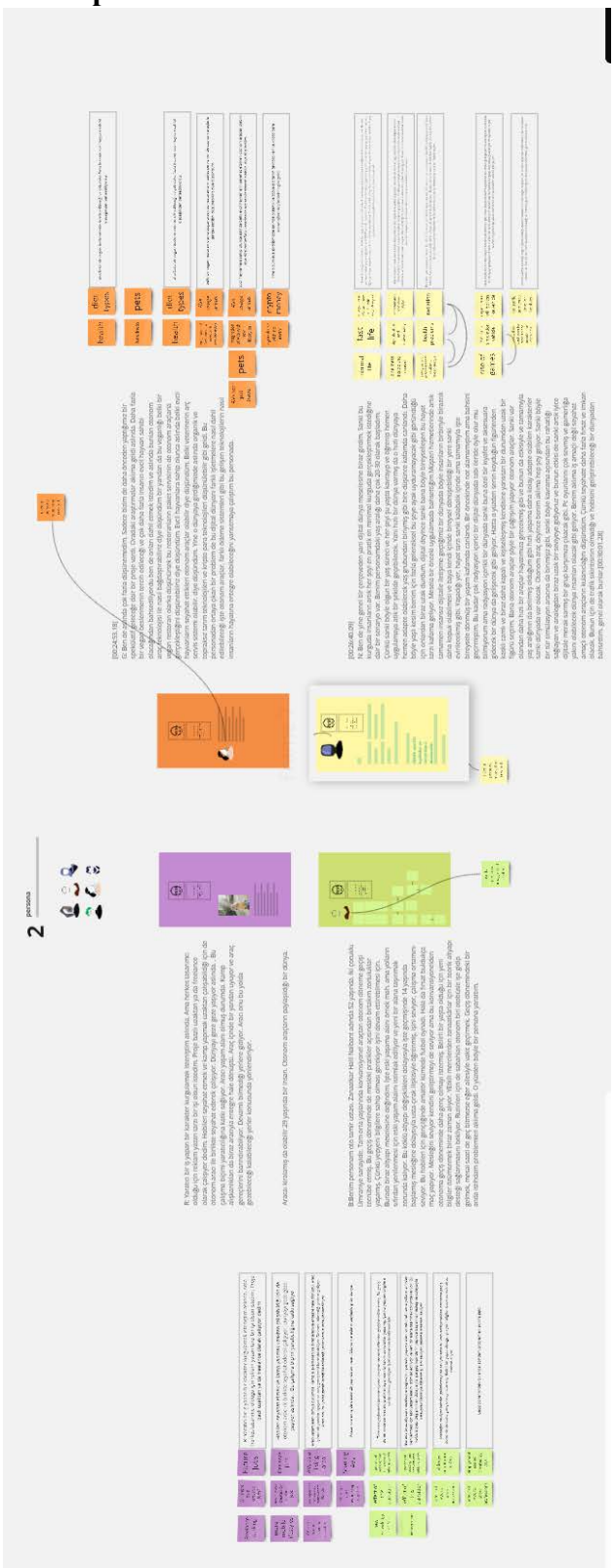
Adı, Yaşadığı yer, Kişilik özellikleri
İlgileri, istekleri, alışkanlıkları,

E. Scenario-Narrative Template (Turkish)

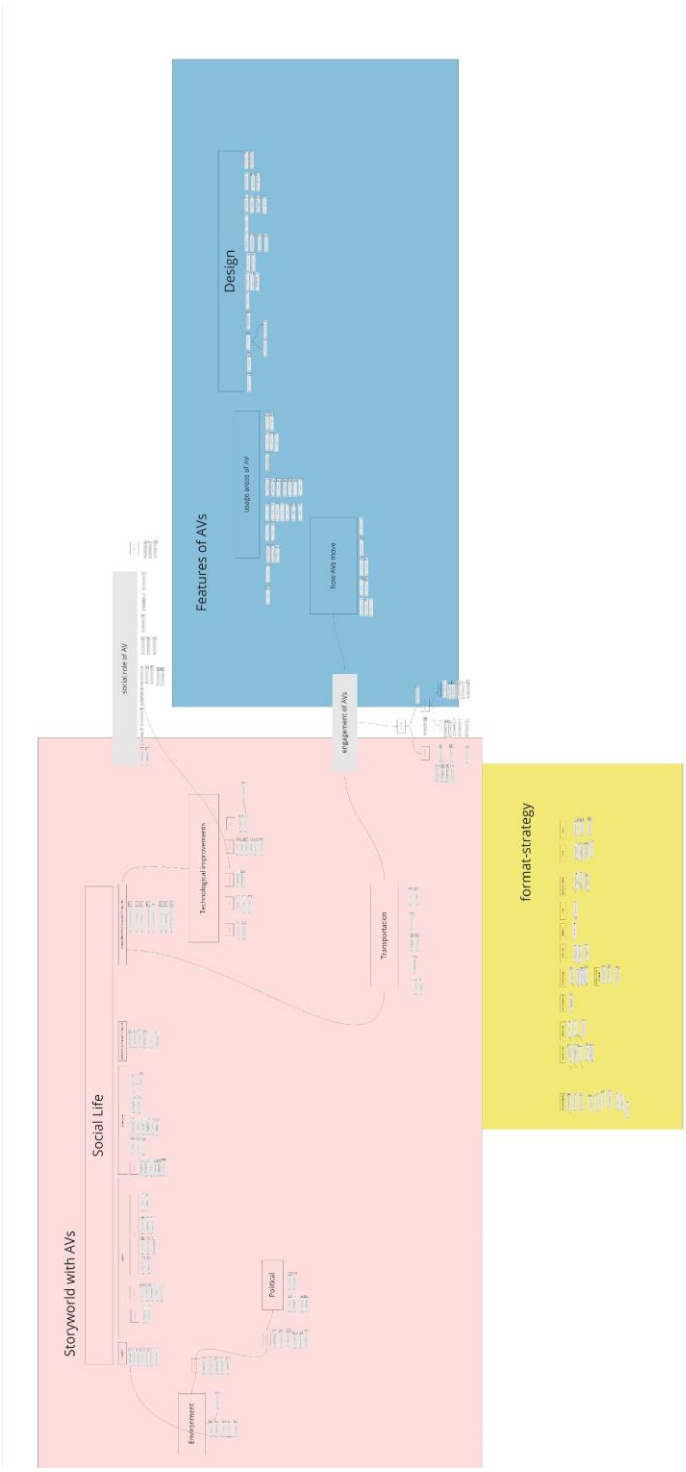


F. Brainstorming of W1P4 (Turkish)

G. Participants' visual data and transcribes



H. Code trees


Features of AVs
Design
usage-areas of AV
how AVs move
engagement of AVs
social role of AV
format-strategy
Storyworld with AVs
Social Life
Technological improvements
Transportation
Political
Environment

I. Quotations And Conversations (Turkish)

[1] Bu sistemde de mekanik bir ahenk söz konusu. Her şey böyle hareketli dönüyor ediyor devam ediyor gibi. Bir arıza olunca hemen çözülüyor.

[2] Evde spor yapmayı sevdiğini, evde bir takım canlılarla simbiyotik ilişkiye girdiğini hayal ettim ve hani bu canlıları ürün gibi düşündüm işte canlılarla birbirlerine bakıyorlar gibi. Evin içinde kendi habitatını oluşturuyor gibi. İşte bireysel ilişkide problemler yaşıyor. Evde kendi enerjisini üretti diye düşündüm alglerden

[3] Kullandığım teknoloji ve kartlara gelirsek: Swarm robotics: Robotların çevresi ile etkileşimi. Mor bölgedeki yaşayanlar araçlara yetişme alışkanlıklarını tespit ediyor ve duraklara gelirken yavaş ya da daha hızlı gelmesini sağlıyor bu otonom araçların onların ivmelerine karar veriyor o verileri topluyor. Bazız memurlarda bu düzene ayak uydurmakta güçlük çektikleri için CRISPR teknolojisi ile biraz daha sorumluluk geni ve dakiklik geni alıyor.

[4] Otonom araç yolcuklarında yetişmedikleri işleri yapıyorlar. Sohbet etmek diş fırçalamak, gazete okumak, böyle şeyleri konolu bir şekilde karşılıyorlar. bu sistemde de mekanik bir ahenk söz konusu. Her şey böyle hareketli dönüyor ediyor devam ediyor gibi. Bir arıza olunca hemen çözlüyor.

[5] Ben ederim. Şimdi politika kısmına aslında hani şey bu program olayları var ya işte telefondaki gizlilik ve whatsapp vs devlet hani bazı durumlarda ulaşabiliyor, ulaşamıyor. Dava durumlarında ortaya dökülüyor. Aslında hani bu işin otonomlukta içinde bulunduğumuz araçtan kaynaklı olarak yani kontrol denetim mekanizmaları ve özel alan işte mahremiyet durumlarına karşı bir şey oluşuyor. Günümüze göre çok daha bu konuda kanunlar vs. olmalı. İşte bir suç işleyecek birini ulaşım esnasında yakalayabilirler. Aynı zamanda gizliliğin

korunması gibi cep telefonunda yaşadığımız şeyler araçlarda da yaşanmaya başlayacak. Politikada bir tek bu geldi aklıma. Ekonomik olarak ücretsiz her yere gidileceğini düşünüyorum. Artık os eviyeye kadar daha kolay. Ulaşım dışı faydalara da hizmet veriyor. Sonuçta hareketli bir mekanizma var bunu sadece ulaşım için değil başka konulara fayda sağlayacak hale gelebilir diye düşündüm. Sosyal yaşam da artık araçlar çok daha konforlu falan olduğu için farklı etkinliklere de hizmet edebilir. Aynı zamanda eğitimle ilgili şeyler de olabilir, çok aklıma gelmiyor sosyal yaşam açıkçası. Teknoloji de işte tabi self-drive 2040 a kalmaz tabi şu an konuşuluyor. ama o zaman iyice oturmuş bir teknoloji olur. Kendi yakıtını artık ne kullanıyorsa onu aslında üretebilen bir yapı olabilir teknolojide.

[6] 2040 biraz fazla yakın gibi. Böyle şey biraz daha sonra fantezi yapabilirdim ben mesela. İşte 20 yıl sonrası çok da radikal değişiklikler olmayacağını düşünüyorum. O benim hayal gücüme kyt vurmuyor değil.

[7] Açıkçası ilk aşamada grup olabilir miydi diye düşündüm içinde bir tasarımcı leadin olduğu gibi bir şeyler olsa daha verimli mi olur? En azından belki ilk aşamayı hep beraber grup olarak yapsaydık belki. Tabi bu ekstra süre ister. Aam daha zengin sonuçlar çıkrabilir.Hele gerçekten bşaka alanalrdan birileri de olsa daha da iyi olurdu. Başka alanlardan olanlar dezavantaj da yaratabilir belki, fikir üretmenin serbestliğine ket vurabiliyor. Yani en azından yakın disiplinler olabilir. Belki şbp, mimarlık vs.Onun dışında birinci aşama iyiydi. Belki bruada keywordleri artırabilirsin. VE tabi grup olursa süre 10 dkye çıkabilir.

[8] Benim de aslında Nalan`ın söylediği gibi dijital alternatif ödeme sistemlerini düşünmüştüm. Ekonomi ile ulaşım arasında aslında Reyhan`ın minibüsçülük yazmasından aklıma gelen toplu taşıma araçlarının otonoma dönüşmesi. Bu

konsept aklıma gelmişti. Daha sonra en basit ilk aklımıza gelen kargo posta hizmetleri ve lojistik hizmetlerinin otonomlaşması aklıma geldi.

[9] Bu kadar çok radyasyon içerici bir diijtal dünyada, tabi ileride öyle olur mu bilmiyorum ama radyasyon içerikli bir dünyada sanki buna özel bir kıyafet ve aksesuara gidecek bir dünya da gelişecek gibi geliyor. Hatta o yüzden senin koyduğun figürlerden kasklı camlı ve biraz daha kapalı ve kişiselleşmiş kendisine yansıtan bir durumdan uzak bir figürü seçtim

J. Approval Ethics

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Sayın Gülay Hasdoğan

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Saygılarımızla bilgilerinize sunarız.

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